



Summary of Progress *of the*
GEOLOGICAL SURVEY
OF GREAT BRITAIN
and the Museum of Practical
Geology for the Year

1932

PART I

LONDON:
PUBLISHED BY HIS MAJESTY'S STATIONERY OFFICE

1933

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Department of Scientific and Industrial Research

Summary of Progress
of the
Geological Survey of Great Britain
and the
Museum of Practical Geology
for the Year 1932

PART I

*With Report of the
Geological Survey Board and
Report of the Director*

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REPORT OF THE GEOLOGICAL SURVEY BOARD FOR 1932

TO THE LORDS OF THE COMMITTEE OF THE PRIVY
COUNCIL FOR SCIENTIFIC AND INDUSTRIAL
RESEARCH

MAY IT PLEASE YOUR LORDSHIPS.—

In accordance with our terms of reference, we, the Geological Survey Board, beg to submit our Thirteenth Annual Report on the work of the Survey and Museum.

ACCOMMODATION (LONDON)

In October, 1932, the Board inspected the new building at South Kensington and noted with pleasure the advanced state that the structure had reached. Rapid progress still continued at the end of December.

Arrangements for the furnishing of the building and for the exhibition of the collections in the new Museum are referred to in a later paragraph of this Report and in the Director's Report.

ACCOMMODATION (SCOTTISH AND PROVINCIAL OFFICES)

In the Edinburgh Office one of the two rooms occupied by the Library and the collection of photographic albums has been equipped with modern steel shelving.

At York a new and more satisfactory branch office at 32, St. Mary's has been provided, and the staff and documents transferred thereto.

The branch offices at Manchester and Newcastle-on-Tyne are being maintained.

FIELD WORK

The Director's Report for 1932, which is submitted herewith, shows that field work was carried out in all the areas specified in the Programme for the year with the exception of the West Highlands District (Inverness-shire).

The Field Units were engaged in the undermentioned districts :—

Southern District (primary six-inch survey).

West Midlands and Cambridge Districts (primary six-inch survey).

2 REPORT OF THE GEOLOGICAL SURVEY BOARD.

Yorkshire District (revision of six-inch survey).
Lancashire District (revision of six-inch survey).
Cumbrian District (revision of six-inch survey).
Northumberland and Durham District (revision of six-inch survey).
Dumfriesshire District (revision of six-inch survey).
Central Coalfield of Scotland (revision of six-inch survey).
Fife District (revision of six-inch survey).
Shetland (primary six-inch survey).

In addition, a rapid examination was made of parts of North Devon, West of England, North and Central Wales, and South of Scotland, where information was needed in connexion with the exhibits in the new Museum.

The reason why work was not commenced in the West Highlands of Scotland—the one item in the Programme not carried out—was that in the early part of the field season the staff was specially engaged on indoor work relating to coalfields.

Details of the work carried out by each of the Field Units mentioned above are given in the *Summary of Progress* (pp. 37-80).

PREPARATIONS FOR THE OCCUPATION OF THE NEW HEADQUARTERS AT SOUTH KENSINGTON

A year ago, the general plans for the arrangement of collections and the display of exhibits in the new Museum were outlined in our Report and fully explained in the Report of the Director. Preparatory work on the lines laid down has been carried on throughout the year. An account of the progress made will be found in the Director's Report (pp. 5-8).

The Board has given further consideration to the scope and arrangement of exhibits, and has approved a general scheme of panoramic illustrations, models, etc.

As regards the representation of the regional geology of Great Britain, mentioned in last year's Report, particulars of the sixteen districts into which the country has been divided together with the names of the officers responsible for the arrangement of the regional exhibits and the descriptive handbooks are now given in the Director's Report (pp. 6-8).

In regard to furnishing it may be mentioned that although such furniture of the Jermyn Street Museum as is suitable is intended for transfer to South Kensington, many new show-cases and cabinets have had to be designed during 1932 and H.M. Office of Works have placed large orders for furniture to be delivered at various dates during 1933.

PUBLICATIONS

Steady progress continues to be made in the publication of maps, memoirs, and vertical sections of strata, and the amount of matter in the press at the close of the year remains large.

In England one new quarter-inch map, eleven new one-inch and thirty-four six-inch maps have appeared; in Scotland one quarter-inch map, eight one-inch and four six-inch maps have been published. Four Scottish Vertical Sections of Strata have also been issued.

Of memoirs published during the year mention may be made of the following:— the Cheviot Hills, the Brompton District, the Country near Saffron Walden, a new edition of the Guide to the Geological Model of the Isle of Purbeck, Area IV of the Economic Geology of the Ayrshire Coalfield, and the Economic Geology of the Stirling and Clackmannan Coalfield.

We are also pleased to report that a large amount of new information regarding the fossils and geological structure of the Kent Coalfield has been collected and that it is intended to publish a selection of the more important geological data in Part II of the *Summary of Progress* for 1932.

AGRICULTURE AND FORESTRY

The Geological Survey has continued to render assistance to the Soils Correlation Committee, a Committee set up by the Ministry of Agriculture and Fisheries in conjunction with the Department of Agriculture for Scotland for the classification of British Soil types. Officers of the Survey accompanied the soil specialists on a tour of certain districts of Scotland, and geological six-inch scale drift maps were placed at the service of the Committee.

The South Ayrshire soil-texture map, referred to in last year's Report, has been published.

A geological surveyor also visited the Pershore fruit-growing area in order to explain the nature of the Drift deposits to assist in determining the best classification of the soil-series already recognised in that district.

Geological information has also been given to the Forest Products Research Laboratory to help in the investigation of the properties of timber grown in various districts of England and Wales.

INVESTIGATION OF BUILDING STONES

Assistance continues to be given to the officers of the Building Research Station in regard to the oolitic limestones, especially Portland Stone and others of similar type, and with the magnesian limestones, such as Anston.

A Geological Survey officer has also visited a number of slate quarries in different parts of Wales together with an officer of the Building Research Station in connexion with an investigation of certain slates.

GEOPHYSICAL WORK

While, as reported in last year's Report, geophysical work in the field has had to be suspended temporarily, we are pleased to report that an officer of the Geological Museum has been able to prepare, in collaboration with Professor E. F. Herroun, a paper for publication by the Royal Society of London on the magnetic properties of certain igneous rocks as bearing on anomalies observed in field surveys.

WATER SUPPLY.

No addition to the series of water-supply memoirs has been published during the year, but one is in preparation on Herefordshire, and several others are in contemplation for various districts of Yorkshire, Lancashire and Cheshire.

Considerable assistance continues to be given to the water authorities of various cities and towns and close touch is being maintained with all the principal engineering firms.

DEATH OF PROFESSOR R. W. DRON

We have to record, with deep regret, the death on the 16th April, 1932, of Professor R. W. Dron, who had been a member of this Board since 1930.

PROGRAMME FOR 1933

The programme of field work approved for 1933 is as follows :—

- (a) primary mapping on the six-inch scale in Shetland, Morvern, Forest of Dean, Droitwich, Sevenoaks, Bridport and Biggleswade;
- (b) revision of original six-inch mapping in the following coalfields and adjacent areas :—Northumberland, Lancashire, Yorkshire, Dumfriesshire, Fife, and Stirling;
- (c) investigation of underground water-supplies, examination of mineral resources, verification of bore records, and collaboration with soil-surveys;
- (d) collection of Museum specimens, photographing of geological subjects for enlargement, field work in connexion with the designing and execution of panoramas for the new Museum.

Several field geologists will be kept at headquarters for the whole year in order to accelerate preparations for the new Museum.

T. FRANKLIN SIBLY,
Chairman.

29th March, 1933.

SUMMARY OF PROGRESS OF THE GEOLOGICAL SURVEY AND MUSEUM FOR 1932

I.—REPORT OF THE DIRECTOR

THE programme of work during the year 1932 was of necessity considerably different from that which is normally adopted for the Geological Survey. This necessity arose from the rapid progress which is being made in building the new Museum in Exhibition Road, South Kensington. At the close of the year the building was nearly completed, only the last stages of the eastern front remaining to be finished. As this front is built of Portland Stone and is of an imposing appearance, with decorative details, the work entailed was somewhat more elaborate and required more time than the rest of the edifice, which is comparatively simple and free from complications. The internal work was in an advanced state, and some of the rooms of the new offices were almost ready for occupation, but much remained to be done in the library, the exhibition galleries and the basement.

It was anticipated that the Survey offices, which are at the back of the building, might be ready for the staff in March, the library and Director's rooms in July, and the Museum proper in October. This programme entailed the active preparation of the collections for removal, which involved much cleaning of specimens and checking of catalogues and registers. Designs had to be prepared for new show-cases for the Museum and new cabinets for the collection rooms. All the furniture of the present Museum that is suitable for the new building is to be transferred. The old wall cases, however, which were specially built for the places they occupy, could not be made use of in the South Kensington building, and as it is intended to show a smaller number of specimens, but with much more explanatory material, such as diagrams, maps and photographs, a large number of the specimens now exhibited under glass will in future be preserved in cabinets where they will be free from dust and immediately available for consultation. The work of designing the new equipment has fallen mainly on the Curator, who has been in constant touch with the staff of H.M. Office of Works. At the close of the year large orders for furniture had been placed, for delivery at various dates during the coming year.

It has been necessary also to take steps to secure a fresh and attractive representation of the principal departments of geology which the Museum is designed to exhibit, and of the methods of

work and the various types of publications of the Geological Survey. Large numbers of enlarged photographs of British geological scenes have been made and mounted. Many diagrams have been prepared to show the geological structure of selected areas of geological interest. New models are being made of several British districts to show the relation of geological structure to surface features, drainage, etc. A series of panoramic displays has been designed showing mining geology and geological processes, and these are being constructed by artists who specialise in this class of work. We are much indebted to mining firms, engineers and others, who have given us maps, plans and photographs necessary for the constructional details of these models and panoramas. These various exhibits had to be designed to fit into the most appropriate and convenient places in the new building.

This work has not only taken up a great deal of the time of certain members of the staff, but has also involved much discussion and consultation with experienced geologists and mining engineers, and a wide study of the literature of the subject. We have received much assistance in this respect from the officers of other museums, British and foreign, and our applications for information, photographs and specimens have been very courteously received and responded to.

Difficulties have arisen from the lack of working space in the present Museum, and the obstruction caused by the temporary erections which support the roof. It is anticipated, however, that in March or April part of the staff can be transferred to South Kensington if the new offices are ready for occupation. This will set free a number of rooms in Jermyn Street, and give more space for active work on the collections. The geological staff which is not employed on Museum work having been shifted, the work of packing the collections in Jermyn Street will make more progress. With the transference of the library and the maps, which is expected to take place in July or August, it will be advisable to shut the present Museum. There is a considerable daily attendance of enquirers and people who desire to consult our library and maps, and these will be referred to the new building, where the library will have much improved accommodation and storage for the books, and ample facilities for public reference. The collection of photographic albums will also be sent to South Kensington.

As the exhibition of stratigraphical geology is to be made on a regional basis and closely connected with the work of the Geological Survey in mapping the various districts of the British Isles, it has been arranged to divide the country into a number of provinces each containing a representative series of geological formations. Some of them, for example, are principally Carboniferous (the North of England), others Cretaceous (South-eastern England), others Tertiary (Hampshire basin). For each province a special place has been assigned on the first gallery of the new

Museum, and exhibits are being planned to illustrate the geology. These include selected specimens of fossils, rocks and minerals characteristic of the provinces, along with diagrams to explain the sequence of the rocks and the geological structure with Geological Survey maps on various scales, solid models to show surface relief, and numerous photographs, enlarged. In this series the geology of the district surrounding London is to have special attention. These rocks, fossils and photographs are being selected from our collections, and labels and diagrams are being prepared, but no final decisions can be made till the new Museum is ready and the materials can be placed in the positions which they will ultimately occupy.

Each of these British geological regions has been placed in charge of a geologist who has an intimate knowledge of its geology. As a preliminary step a brief synopsis has been drawn up for each district, with a list of the materials required to show its principal geological features. In some cases where our existing collections proved inadequate, as there had been considerable advances in our knowledge of the geology of the district since it was last mapped by the Geological Survey, collectors have been sent out to obtain specimens needed to make the representation complete. Many new photographs have also been taken of geological scenes likely to improve the value of the exhibits. This work is still in progress, but much has been accomplished during the past year, and the assembling of the collections and the drafting of the explanatory labels has gone on continuously. It is proposed ultimately to print a set of short illustrated handbooks descriptive of the geology and scenery of the different regions of Great Britain, and the manuscripts are now in first draft, but are not yet ready to be sent to the printer.

The districts into which the country has been divided and the officers who are chiefly responsible for the exhibits and for preparing the descriptive accounts are as follows :—

England and Wales :—

London and Thames Basin	...	Dr. R. L. Sherlock
The Weald	... ..	Mr. F. H. Edmunds
The Hampshire Basin	... ..	Mr. C. P. Chatwin
South-western England	... ..	Mr. H. Dewey
East Yorkshire and Lincolnshire	...	Mr. C. E. N. Bromehead
East Anglian District	... ..	Mr. C. P. Chatwin
Central England	... ..	Dr. R. L. Sherlock
North Wales	... ..	Dr. Bernard Smith and Dr. T. N. George
Welsh Borders	... ..	Mr. T. H. Whitehead and Dr. R. W. Pocock
South Wales	... ..	Dr. H. H. Thomas
The Pennines and Adjacent Areas	... ..	Dr. D. A. Wray

Northern England	... ..	Mr. T. Eastwood and
		Mr. R. G. Carruthers
Bristol and Gloucester District		Dr. R. Crookall

Scotland :—

The Southern Uplands	... ..	Dr. J. Pringle
The Central Valley	... ..	Dr. M. Macgregor
The Central and South-west Highlands		Prof. H. H. Read
The North-west Highlands	... ..	Dr. J. Phemister
Scottish Tertiary Province	... ..	Mr. J. E. Richey

The second or uppermost gallery of the new Museum will be devoted to economic geology, and will contain exhibits of building stones, clays, abrasives, the ores of the metals, etc. The preparations for this gallery have been in the hands of Mr. Hallimond, who has been assisted by Mr. Eyles and other geologists. Much of the material now displayed to illustrate these subjects will be of use, but it is being supplemented where necessary by additional specimens, and illustrated by many diagrams, plans and economic maps. Descriptive labels are being prepared for printing and a few models and panoramas are in contemplation, but not yet completed. British mineral industries, such as coal and iron ores, tin, cement, china-clay and oil-shale will be freely represented. A special series to show the origin, varieties and properties of British coals is in an advanced stage of preparation. This gallery is intended to interest specially students of mining and the industrial applications of geology. It will correspond to the exhibits of mining apparatus in the adjacent Science Museum.

In the library and offices a good deal of work has been done in sorting out the books and records and preparing them for their places in the new Museum, but final arrangements and revision of catalogues and indexes cannot be undertaken till more is known regarding their ultimate disposition in the accommodation that is being provided for them.

Field Work

These details of Museum work are estimated to have occupied about one third of the time of the staff. The remainder has been about equally divided between field work and the preparation of maps and memoirs for the press. For many of the geologists the field season did not begin till September, and the weather conditions were not always favourable for rapid progress. In addition to the usual districts in which work was a continuation of that which had been in hand during the previous year, it was found possible to make a rapid examination of some parts of the country where information was needed in connexion with the exhibits in the new Museum. These districts included North Devon, North

and Central Wales, the South of Scotland and some areas in the West of England. The opportunity was also taken to add to our collections of British photographs some much needed negatives of typical scenery in outlying districts. The Curator of the Museum also paid visits to mines, quarries, etc., that seemed likely to be suitable subjects for pictorial or graphic representation of British mining industries.

In the South-east of England Mr. Dewey and his staff continued primary six-inch survey in the Sevenoaks Sheet (287) The officers engaged were Mr. Dines and Mr. Buchan.

In the Bridport Sheet (327) Mr. Lloyd continued field work on the six-inch scale and was accompanied by Dr. Welch and towards the close of the year by Mr. Buchan.

The Lizard district of Cornwall, of which the revised colour-printed map (Sheet 359) published in 1912 has been out of print for several years, was visited by the Director, who has introduced important alterations into the northern half of that Sheet, and has prepared a revised edition which is now being engraved.

In the Midlands District, under Mr. Dinham, work was continued in two areas involving three Sheets. The Dudley Sheet (167) was finished during the year by Messrs. Whitehead and Pocock. Work is now being continued in the Droitwich Sheet (182) to the south where a considerable area has been mapped by Dr. George. These two Sheets contain Coal Measures belonging to the South Staffordshire, Coalbrookdale and Forest of Wyre coalfields, and with their completion the re-survey of the West Midland coalfields will be achieved (except the small coalfield of Cleve Hill).

Mr. Dixon and Dr. Sherlock continued revising the Biggleswade Sheet (204), on the six-inch scale. This is one of the four one-inch Sheets that surround Cambridge, of which a revised and adequate series of maps has long been a desideratum. About two-thirds of this Sheet have now been revised.

In the Yorkshire Coalfield Mr. Bromehead and four geologists working from headquarters in York have been actively engaged in preparing new six-inch maps in the two one-inch Sheets Wakefield (78) and Barnsley (87). Both of these Sheets contain much coal and as they have not been revised for 50 years there is much mining information to be collected and studied. The revision is about two-thirds done and it is possible that both of these Sheets will be finished in 1933, and preparing for publication.

In the Lancashire District Dr. W. B. Wright and two geologists have spent nearly the whole field season in the Wigan Sheet (84). Some work has also been done in the Stockport Sheet (98) and in the Preston Sheet (75). The Wigan map is nearly completely revised and the six-inch Quarter Sheets are mostly either engraving or preparing for the press. In the other two

Sheets above mentioned work has as yet not reached an advanced stage.

In Cumberland Mr. Eastwood with his staff of three geologists has finished the mapping of the Cockermouth Sheet (23) which completes the revision of the West Cumberland Coalfield. Towards the close of the season they began the revision of the Gosforth Sheet (37) which contains fairly important deposits of iron ores. This Sheet was also completed before the end of the year.

In Northumberland Mr. R. G. Carruthers and his staff have been at work in three Sheets. Of these, Tynemouth (Sheet 15) is practically finished and work is being pushed in Morpeth (Sheet 14). Both of these Sheets contain important coal seams worked extensively for many years. Farther inland, at the south edge of the Cheviots, the Elsdon Sheet (8) has also been partly resurveyed. It contains coal deposits which have been worked on a small scale and are not of great value.

The field season in Scotland was not started till September as the staff were busy in the office writing memoirs on coalfields and seeing the maps through the press. No work was done in the West Highlands as owing to the sporting season it was impossible to get access to the ground.

In Shetland, however, Mr. G. V. Wilson and two geologists had two months' work, partly in the north and partly in the west of the Mainland. The eight one-inch Sheets of Shetland have now been in large measure surveyed but they cannot be published till the whole series is finished. This will probably require at least one more field season.

In the coalfield areas of Scotland the revision begun in 1900 is now nearly ended. During the last field season Mr. Knox and Mr. Allan were engaged in East Fife and have practically finished revising the Leven Coalfield. Dr. Robertson has been busy preparing a memoir on the Kilsyth Coalfield, which will be the last of the series of Economic Memoirs on the Central Coalfield of Scotland. In connexion with this work he has spent some time in the field. Some new six-inch maps of Stirlingshire (second revision) have been passing through the press.

Mr. Richey and his staff were busy in the autumn in the Sanquhar Coalfield of Dumfriesshire which is one of the small outlying fields that fringe the Southern Uplands. This revision has been brought to a stage approaching completion and the six-inch maps will soon be put in hand. The unrevised area of coalfield in Scotland is now reduced to very small dimensions.

Some field work which has considerable interest from its bearing on the Carboniferous sequence in Scotland was also done in the Thornhill basin of Dumfriesshire by Mr. Richey and Dr. John Pringle.

The reports of the District Officers on the principal new points that have arisen in the course of the year's work in the districts above enumerated will be found in subsequent pages.

Publications

The list of maps and memoirs published during the year and of those which are in the press will be found on pp. 14-19.

MAPS

Of the English maps Sheet 3, Ford; Sheet 5, Cheviot; Sheet 86, Glossop; Sheet 152, Shrewsbury; and Sheet 286, Reigate, have been completely revised on the six-inch scale. They are published both as 'Drift' and as 'Solid' maps when they contain coalfield; but the Cheviot Sheet (5) and the Reigate Sheet (286), which contain no coal seams, have been issued only in a 'Drift' edition. The Saffron Walden map (Sheet 205) appears for the first time in colour-printed form, and the new issue shows much additional detail regarding the 'Drift' which has been carefully surveyed on the six-inch scale for this map. The other two one-inch maps published during the year under review, Atherstone (Sheet 155) and Abergavenny (Sheet 232) had previously appeared in revised and colour-printed form and are reprinted according to the scheme of colour-printing now used. Parts of the Atherstone map have been modified by incorporation of new details. The Abergavenny map has received a considerable amount of revision at the hands of Dr. Robertson, and a new edition of the memoir and new six-inch maps of the coalfield have already been published. This indicates that the maps and memoirs based on the six-inch survey carried out under Sir Aubrey Strahan as District Geologist in 1897 and subsequent years are now in several cases sold out, and are being replaced as fast as circumstances permit.

In Scotland, among the maps published during the year, the principal place is taken by six maps of the Orkney Islands, based on a six-inch survey. The total land area in these six maps is about equal to that included in an ordinary Scottish one-inch geological Sheet or in two English Sheets. These maps are issued only in a 'Drift' edition but a 'Solid' map of the county has been printed on the smaller scale of four miles to one inch. The Peebles map (Sheet 24) is a revised edition containing the work of Dr. Peach and Dr. Horne on the graptolite zones and also new details regarding the igneous rocks. The Ayr map (Sheet 14) is the first of three which will represent the 'Drift,' 'Solid' and 'Soil Textures' of Southern Ayrshire.

Of the six-inch maps of coalfields, 38 have been published; thirty-four are English and four are Scottish. As pointed out in last year's *Report* (p. 16), the decreasing number of six-inch

Scottish maps that appear each year marks the approaching completion of the first revision of the Scottish coalfields that was started in 1900. Some of the six-inch maps of Stirlingshire are now being issued in a new form as the Ordnance Survey has prepared a 'new series' for this county on a changed meridian. Consequently the boundaries of the Sheets do not coincide with those of the series previously issued. These 'new series' Stirlingshire maps are receiving such modifications and additions as arise from the constantly increasing information regarding the structure of the coalfield, as revealed by the progress of boring and mining operations. The topographical detail has also been brought up to date so that in all respects these maps may be regarded as new editions.

Of the new maps that are passing through the press the most notable are four sheets on the scale of four miles to one inch; these belong to a new edition of this popular map printed with an improved scheme of colours and brought up to date wherever changes had become desirable. Of the one-inch maps the Cirencester Sheet (235) replaces an old hand-coloured edition but is improved by the representation of the drifts which have been specially surveyed by Mr. Dines. The Fareham Sheet (316) replaces a colour-printed map issued in 1905 and now sold out. The alterations are not in this case extensive and relate principally to the 'Drift.' In the Lizard Sheet (359) there are extensive modifications in the country which lies to the north of the Lizard crystalline complex, essentially due to recent discoveries by Miss E. M. Lind Hendriks of fossils that have been described and figured by Professor W. H. Lang, F.R.S.¹

MEMOIRS

The English memoirs published during the year include three that are descriptive of the areas shown on New Series one-inch maps that have come recently from the press. These are 'Brampton,' 'The Cheviots' and 'Saffron Walden.' Four others are being printed, *viz.*, 'Merthyr Tydfil' (2nd edition), 'Torquay' (2nd edition), 'Cirencester' and 'Glossop.' A new memoir on the Reigate district is in an advanced state of preparation.

It is interesting to note that the little descriptive account of the Purbeck district, that was written by Sir Aubrey Strahan to describe the model exhibited in the Museum of Practical Geology, has sold out. It has been reprinted practically without alteration. This district is a beautiful example of tectonics, and the model is deservedly popular with teachers of geology who bring classes to the Museum. A special Sheet of the Purbeck district, with a brief description of surface features and geology, has recently been published by the Ordnance Survey, compiled and edited by a committee of geographical authorities.

¹ 'On Fossil Wood (*Dadoxylon Hendriksi*, n. sp.) and other Plant-remains from the Clay-Slates of South Cornwall,' *Annals of Botany*, vol. xliii, no. clxxii, pp. 663-681.

The only Scottish memoirs published during the year are two of the series on Economic Geology. One is for South Ayrshire and completes the account of the Ayrshire Coalfield. The other is for the Stirling and Clackmannan Coalfield. Other Economic Memoirs are in the press or are being written. They include an account of the Bo'ness field and one of the Kilsyth field (which will complete the description of the Central Coalfield), and two on Fifeshire. It is probable that several of these will be published during the coming year. These memoirs will be followed by descriptions of the Douglas Coalfield and the Sanquhar Coalfield which are not yet compiled. In this manner the new series of six-inch maps of the Scottish coalfields will be accompanied by special memoirs giving all details of economic interest that have been gathered during the re-survey of the fields.

WATER SUPPLY MEMOIRS

No additional volume of the series of memoirs on Water Supply has been published during the year, though one is in preparation on the water supply of Herefordshire. Several others are in contemplation for various districts of Yorkshire, Lancashire and Cheshire, and the records are being collected and filed; but the field staff working in these areas is at present very busily employed in re-surveying important parts of the coalfields, and in preparing the six-inch maps for publication. In nearly all the memoirs descriptive of the New Series colour-printed geological Sheets, chapters on the wells, borings and underground water supply of the area represented on the Sheet are included.

Towards the close of the year a committee appointed by the British Association to inquire into the position of Inland Water Survey in the British Isles had held several meetings, and had begun the task of collecting data. On this committee Dr. Bernard Smith is serving as a representative of the Geological Survey, and has prepared a memorandum on the Survey's methods of collecting particulars of wells and borings. Although the Geological Survey has no powers to inspect borings for water and does not receive compulsory notification of borings about to be started, we are in close touch with all the principal engineering firms that do this kind of work and they, as a rule, most willingly give us particulars and specimens of the rocks penetrated in the wells; in return it is usual for us to keep those firms informed of the geological horizons which they have reached, a matter of great importance when water-bearing strata are being sought for. In this way a very large amount of information comes to us every year. These data serve for the Water Supply Memoirs, and as time elapses the published material becomes supplemented by much additional information, which is of great importance, as it has been recently collected and has usually been carefully checked by our geologists and assistants, who make personal visits to new borings that are likely to yield useful geological data.

The demand for information regarding water supplies has become very insistent in the south-east of England, and particularly in the vicinity of London, partly for new industries and partly from the increasing requirements for domestic consumption. Among the interesting enquiries received during the year were several regarding the Southampton water supply and the new docks at Southampton. These were of considerable importance. Geological information was also given regarding proposed new schemes of water supply for Hull. Several important undertakings in the west of England also received attention. In the Newcastle-on-Tyne district deep boring for water has been successfully carried on, and the bore records have been very carefully scrutinised as they illustrate a series of rocks of which our information had hitherto been rather defective. Full access to these works has been given by the engineers in charge. A large amount of new information has also been collected from water borings in and around Leeds, Wakefield and Dewsbury, and in the Manchester, Salford and Wigan districts. These are often of great value, as proving the existence and location of faults in Coal Measures strata that would otherwise be less easily recognized.

The following maps, vertical sections and memoirs were published in 1932:—

I.—MAPS.

English and Welsh Maps published in 1932

½ inch to 1 mile :—

Sheet 19.—Bath, Guildford, Abingdon, Southampton (*Solid, Revised*).

1 inch to 1 mile :—

Sheet 3.—Ford (*Solid, new edition*). Original survey by W. Gunn and C. T. Clough. Re-surveyed by R. G. Carruthers, C. H. Dinham, G. A. Burnett, A. Fowler and F. Marsden; R. G. Carruthers, District Geologist.

Sheet 3.—Ford (*Drift, new edition*). See above.

Sheet 5.—Cheviot (*Drift, new edition*). Original survey by C. T. Clough. Re-surveyed by G. A. Burnett and W. Anderson; R. G. Carruthers, District Geologist.

Sheet 86.—Glossop (*Solid*). Original survey published on Old Series maps. Re-surveyed by Wilfrid Edwards, D. A. Wray, G. V. Wilson, J. V. Stephens, W. Lloyd, and C. E. N. Bromehead, District Geologist.

Sheet 86.—Glossop (*Drift*). See above.

Sheet 152.—Shrewsbury (*Solid*). Original survey on one-inch scale. Re-surveyed on six-inch scale by T. C. Cantrill, R. W. Pocock, T. Robertson, C. B. Wedd, T. H. Whitehead and D. A. Wray; T. C. Cantrill and C. H. Dinham, District Geologists.

Sheet 152.—Shrewsbury (*Drift*). See above.

Sheet 155.—Atherstone (*Drift, reprinted with corrections*). Original survey on one-inch scale by A. C. Ramsay, H. H. Howell and E. Hull. Revised in part by A. Strahan in 1886. Re-surveyed on six-inch scale by C. Fox-Strangways and W. W. Watts (Pre-Cambrian rocks). Revised (Warwickshire Coalfield) by G. Barrow in 1912.

Sheet 205.—Saffron Walden (*Drift*). Original survey on one-inch scale by W. H. Penning, A. J. Jukes-Browne and others under the supervision of W. Whitaker. Published on Old Series Sheets. Re-surveyed in part on the six-inch scale by H. G. Dines and F. H. Edmunds; H. Dewey, District Geologist.

Sheet 232.—Abergavenny (*Drift, revised*). Original survey by Sir H. T. De la Beche and D. H. Williams. Re-surveyed by J. R. Dakyns, A. Strahan and W. Gibson. Revised by T. Robertson.

Sheet 286.—Reigate (*Drift*). Original survey on one-inch scale. Revised on six-inch scale by H. Dewey, H. G. Dines and F. H. Edmunds; H. Dewey, District Geologist.

6 inches to 1 mile (coalfield maps):—

Brecknockshire, 43 N.E.—Tawe Valley. Original survey by A. Strahan. Revised by T. Robertson.

Brecknockshire, 44 S.E.—Valley of Neath (Upper). Original survey by A. Strahan. Revised by T. Robertson.

Brecknockshire, 46 S.W.—Dowlais. Original survey by W. Gibson. Revised by T. Robertson.

Brecknockshire, 49 N.E.—Pont-Nedd-Fechan. Original survey by A. Strahan. Revised by T. Robertson.

Brecknockshire, 50 N.W.—Hirwaun. Original survey by W. Gibson. Revised by T. Robertson.

Brecknockshire, 50 N.E.—Mynydd Aberdar. Original survey by W. Gibson. Revised by T. Robertson.

Brecknockshire, 51 N.W.—Merthyr Tydfil. Original survey by W. Gibson. Revised by T. Robertson.

Cumberland, 36 S.W.—Plumbland, Bothel. Original survey by T. V. Holmes. Re-surveyed by T. Eastwood; B. Smith, District Geologist.

Cumberland, 45 N.E.—Gilcrux, Tallentire. Original survey by R. Russell. Re-surveyed by T. Eastwood; B. Smith, District Geologist.

Glamorganshire, 9 S.E.—Resolven. Original survey by A. Strahan and W. Gibson. Revised by T. Robertson.

Glamorganshire, 10 S.W.—Cwm-Gwrach. Original survey by W. Gibson. Revised by T. Robertson.

Glamorganshire, 10 S.E.—Llyn Fawr. Original survey by W. Gibson. Revised by T. Robertson.

Glamorganshire, 11 S.W.—Mynydd Bwlfa. Original survey by W. Gibson. Revised by T. Robertson.

Glamorganshire, 11 S.E.—Aberdare. Original survey by W. Gibson. Revised by T. Robertson.

Glamorganshire, 12 S.W.—Troed-y-rhiw. Original survey by W. Gibson. Revised by T. Robertson.

Lancashire, 86 N.E.—Smithills Dean. Original survey by E. Hull. Re-surveyed by W. B. Wright and R. C. B. Jones; W. B. Wright, District Geologist.

Lancashire, 86 S.E.—Bolton. Original survey by E. Hull. Re-surveyed by R. C. B. Jones; W. B. Wright, District Geologist.

Lancashire, 89 S.E.—Clough. Original survey by E. Hull and A. H. Green. Re-surveyed by W. Lloyd, Wilfrid Edwards and D. A. Wray; W. B. Wright and C. E. N. Bromehead, District Geologists.

Lancashire, 92 N.E.—Skelmersdale. Original survey by E. Hull. Re-surveyed by Laurance H. Tonks; W. B. Wright, District Geologist.

Lancashire, 97 S.E.—Mossley. Original survey by E. Hull and J. R. Dakyns. Re-surveyed by W. Lloyd and Wilfrid Edwards; W. B. Wright and C. E. N. Bromehead, District Geologists.

Lancashire, 105 N.E.—Stalybridge. Original survey by E. Hull and J. R. Dakyns. Re-surveyed by W. Lloyd and W. Edwards; W. B. Wright and C. E. N. Bromehead, District Geologists.

- Lancashire, 105 S.E.—Dukinfield. Original survey by E. Hull. Re-surveyed by W. Lloyd, W. Edwards and J. V. Stephens; W. B. Wright and C. E. N. Bromehead, District Geologists.
- Northumberland, N.51 N.E.—South Broomhill. Original survey by W. Topley. Revised by A. Fowler; R. G. Carruthers, District Geologist.
- Northumberland, N.60 S.W.—Hebron. Original survey by W. Topley. Revised by A. Fowler; R. G. Carruthers, District Geologist.
- Northumberland, N.61 N.W.—Ellington. Original survey by W. Topley. Revised by A. Fowler; R. G. Carruthers, District Geologist.
- Northumberland, N.69 N.E.—Pegswood. Original survey by W. Topley. Revised by A. Fowler; R. G. Carruthers, District Geologist.
- Northumberland, N.70 N.W.—Ashington. Original survey by W. Topley. Revised by A. Fowler; R. G. Carruthers, District Geologist.
- Staffordshire, 67 N.W.—Baggeridge. Surveyed by T. H. Whitehead; W. Gibson and C. H. Dinham, District Geologists.
- Staffordshire, 67 S.W.—Himley. Surveyed by T. H. Whitehead; W. Gibson and C. H. Dinham, District Geologists.
- Staffordshire, 71 N.W.—Kingswinford. Surveyed by T. H. Whitehead; W. Gibson, District Geologist.
- Yorkshire, 218 S.W.—Hunslet. Original survey by J. C. Ward and R. Russell. Re-surveyed by Wilfrid Edwards; C. E. N. Bromehead, District Geologist.
- Yorkshire, 247 S.E.—Thornhill. Original survey by A. H. Green, J. C. Ward and R. Russell. Re-surveyed by D. A. Wray; C. N. Bromehead, District Geologist.
- Yorkshire, 261 N.E.—Flockton. Original survey by A. H. Green, J. C. Ward and R. Russell. Re-surveyed by D. A. Wray; C. N. Bromehead, District Geologist.
- Yorkshire, 290 N.W.—Ravenfield. Original survey by W. T. Aveline, A. H. Green and T. V. Holmes. Re-surveyed by G. H. Mitchell; C. N. Bromehead, District Geologist.

Scottish Maps published in 1932

$\frac{1}{4}$ inch to 1 mile :—

Sheet 3.—Orkney Islands (*Solid*).

1 inch to 1 mile :—

- Sheet 14.—Ayr (*Soil Texture*). Surveyed by D. N. McArthur, C. L. Whittles, J. C. Jack and C. Loudon of the West of Scotland Agricultural College.
- Sheet 24.—Peebles (*Solid with Drift*). Original survey by A. Geikie, H. H. Howell, J. Young and J. Geikie. Ordovician and Silurian revised by B. N. Peach and J. Horne. Post-Silurian revised by J. E. Richey, H. H. Read, J. Phemister and W. Q. Kennedy.
- Sheet 117.—Hoy, Orkney Islands (*Drift*). Surveyed by B. N. Peach, J. V. Stephens, Wilfrid Edwards and J. Knox; G. V. Wilson, District Geologist.
- Sheet 118.—Copinsay, Orkney Islands (*Drift*). Surveyed by Wilfrid Edwards and J. Knox; G. V. Wilson, District Geologist.
- Sheet 119.—Kirkwall, Orkney Islands (*Drift*). Surveyed by G. V. Wilson, J. V. Stephens, J. Knox and R. C. B. Jones; G. V. Wilson, District Geologist.
- Sheet 120.—Stronsay, Orkney Islands (*Drift*). Surveyed by J. Knox and R. C. B. Jones; G. V. Wilson, District Geologist.
- Sheet 121.—Westray, Orkney Islands (*Drift*). Surveyed by G. V. Wilson and R. C. B. Jones; G. V. Wilson, District Geologist.
- Sheet 122.—Sanday, Orkney Islands (*Drift*). Surveyed by G. V. Wilson and R. C. B. Jones; G. V. Wilson, District Geologist.

6 inches to 1 mile (coalfield maps) :—

- Ayrshire, 36 S.W.—High Garleffan. Original survey by B. N. Peach. Revised by E. M. Anderson and J. B. Simpson; E. B. Bailey, District Geologist.
- Lanarkshire, 37 S.E.—South Bankend. Original survey by B. N. Peach. Revised by C. B. Crampton and G. Ross; M. Macgregor, District Geologist.
- Lanarkshire, 38 S.W.—Douglas. Original survey by B. N. Peach. Revised by G. Ross and J. Phemister; M. Macgregor, District Geologist.
- Stirlingshire, N.30 N.E.—Falkirk. Original survey by A. Geikie and B. N. Peach. Revised by C. T. Clough, J. S. Grant Wilson, C. B. Crampton and E. M. Anderson.

Manuscript copies of the following maps on the scale of six inches to one mile were deposited in the Library for public reference. They are not to be published. The English maps are deposited in the head office in London. These manuscript copies of unpublished maps may be examined in the Library of the Geological Survey on week-days from 10 a.m. to 5 p.m. Copies of them may be obtained at the cost of drawing, which will be quoted on application to the Superintendent of Maps. Photographs of these maps will also be supplied on the scale of 3 inches to one mile approximately, at the cost of 2s. 6d. to 3s. 6d. per quarter-sheet.

The Scottish manuscript copies which are deposited in the office at 19, Grange Terrace, Edinburgh, may on application be forwarded to the London office for consultation.

Library Copies of English Manuscript Standard Maps Deposited for Reference

- Berkshire, 23 N.E.
 Hampshire, 42 N.W., N.E., S.W., S.E.; 44 N.W., N.E., S.W., S.E.;
 48 N.W., N.E., S.W., S.E.
 Lancashire, 84 N.W.
 Northumberland, N.98 N.W. (part), S.W. (part).
 Sussex, 50 N.W., N.E., S.W., S.E.
 Yorkshire, 264 S.E.; 276 N.E., S.E.; 284 N.E.; 290 N.E., S.E.

Scottish Manuscript Maps Deposited for Reference

- Buteshire, 253 N.E., S.E.; 254 N.W., N.E., S.W., S.E.; 255 N.W., S.W.

List of Maps in the Press at the Close of 1932

English Maps in the Press

$\frac{1}{4}$ inch to 1 mile :—

- Sheet 7.—Leeds, Manchester, York (*Solid, new edition*).
 Sheet 14.—Aberystwyth, Carmarthen, Hereford (*Solid, new edition*).
 Sheet 16.—Cambridge, Colchester, Ipswich (*Solid, new edition*).
 Sheet 20 with 24.—London, Dover, Brighton (*Solid and Drift, new editions*).

1 inch to 1 mile :—

- Sheet 9.—Rothbury (*Solid, new edition*).
 Sheet 9.—Rothbury (*Drift, new edition*).
 Sheet 10.—Woodhorn (*Solid, new edition*).
 Sheet 10.—Woodhorn (*Drift, new edition*).
 Sheet 235.—Cirencester (*Drift*).
 Sheet 316.—Fareham (*Drift, new edition*).
 Sheet 359.—Lizard (*Drift, new edition*).

6 inches to 1 mile :—

- Lancashire, 83 N.E., S.E.; 84 N.E., S.W., S.E.; 85 N.W., N.E., S.E.;
 86 N.W.; 91 N.E., S.E.; 92 N.W., S.W.; 94 N.W., N.E.; 100 N.W.,
 N.E., S.W.; 101 N.W., S.W.; 108 N.E.; 109 N.W.
 London, N.1 N.W., N.E., S.W., S.E.; N.2 N.W., N.E., S.W.,
 S.E.; N.4 N.W., N.E., S.W.; N.6 N.W.
 Yorkshire, 219 S.W.; 273 N.E., S.E.; 276 N.W.; 284 S.W.

*Scottish Maps in the Press***1 inch to 1 mile :—**

- Sheet 9.—Maxwelltown (*Solid with Drift*).
 Sheet 14.—Ayr (*Solid*).
 Sheet 14.—Ayr (*Drift*).

6 inches to 1 mile (coalfield maps) :—

- Fifeshire, 27 N.E.
 Stirlingshire, N.24 S.W., S.E.; N.30 N.W.

II. VERTICAL SECTIONS OF STRATA*Scottish Vertical Sections Published in 1932*

- Sheet 17.—Vertical Sections illustrating the North-East Stirlingshire Coalfield.
 Sheet 18.—Vertical Sections illustrating the Clackmannan Coalfield (including part of West Fife).
 Sheet 19.—Vertical Sections illustrating the Fife Coalfields, Area I. Dunfermline and West Fife.
 Sheet 20.—Vertical Sections illustrating the Ayrshire Coalfields, Area IV. Dailly, Patna, Rankinston, Dalmellington and New Cumnock districts.

Scottish Vertical Sections in the Press at the Close of 1932

- Sheet 21.—Vertical Sections illustrating the Fife Coalfields, Area II. Cowdenbeath, Leslie and Kirkcaldy districts.

III. MEMOIRS*English Memoirs Published in 1932*

- Summary of Progress of the Geological Survey of Great Britain and the Museum of Practical Geology for the year 1931 :—

Part I.—With Report of the Geological Survey Board and Report of the Director. 81 pp. 1932. Price 1s. 6d. *net*.

Part II.—166 pp., 4 plates, 18 text-figures. 1932. Price 3s. *net*.

- Guide to the Geological Model of the Isle of Purbeck. By Aubrey Strahan, M.A., F.R.S. *Second Edition*. 28 pp., 2 plates, 1 text-figure. 1932. Price 6d. *net*.
- The Geology of the Cheviot Hills. (Explanation of one-inch Sheets 3 and 5: England and Wales). (Based on the work of C. T. Clough and W. Gunn). By R. G. Carruthers, G. A. Burnett, B.Sc., and W. Anderson, M.Sc. With Petrological Notes by H. H. Thomas, Sc.D., F.R.S. 174 pp.; 7 plates, 2 text-figures. 1932. Price 4s. *net*.
- The Geology of the Brampton District. (Explanation of one-inch Sheet 18: England and Wales). By F. M. Trotter, D.Sc., and S. E. Hollingworth, M.A., D.Sc. 223 pp., 9 plates, 17 text-figures. 1932. Price 5s. *net*.
- The Geology of the Country near Saffron Walden. (Explanation of one-inch Sheet 205: England and Wales). By H. J. Osborne White, F.G.S. With contributions by F. H. Edmunds, M.A. 125 pp., 5 plates, 15 text-figures. 1932. Price 3s. *net*.

Scottish Memoirs Published in 1932

- Summary of Progress. See p. 18.
- Economic Geology of the Ayrshire Coalfields. Area IV—Dailly, Patna, Rankinston, Dalmellington and New Cumnock. By J. B. Simpson, B.Sc., and A. G. MacGregor, M.C., B.Sc. With contributions by J. E. Richey, M.C., B.A., and V.A. Eyles, B.Sc. 167 pp., 3 plates, 15 text-figures. 1932. Price 3s. 6d. *net*.
- The Economic Geology of the Stirling and Clackmannan Coalfield. By C. H. Dinham, B.A., and D. Haldane, B.Sc. 242 pp., 3 plates, 13 text-figures. 1932. Price 4s. 6d. *net*.

English Memoirs in the Press at the Close of 1932

- The Geology of the Country around Holmfirth and Glossop. (Explanation of one-inch Sheet 86: England and Wales).
- The Geology of the South Wales Coalfield. Part V. Merthyr Tydfil. (Explanation of one-inch Sheet 231: England and Wales). *Second Edition*.
- The Country around Cirencester. (Explanation of one-inch Sheet 235: England and Wales).
- The Geology of the Country around Torquay. (Explanation of one-inch Sheet 350: England and Wales). *Second Edition*.

Scottish Memoirs in the Press at the Close of 1932

- The Economic Geology of the Central Coalfield. Area III—Bo'ness and Linlithgow.

Geophysical Work

As was stated in last year's *Report* (p. 23) it was decided to close down geophysical work in the field owing to the pressure of other duties in connection with the preparation for the transfer of our collections and records to the new Museum. Our geophysical instruments were, with the consent of the Advisory Council, lent to the new School of Geophysics which is being conducted by Professor Rankine at the Imperial College of Science, South Kensington, where they have served a useful purpose both for

class demonstration and for field work. The preparation of reports on the geophysical surveys already made was continued and a special investigation was made by Mr. Hallimond and Professor E. F. Herroun on the magnetic properties of certain igneous rocks as bearing on anomalies observed in field surveys. It was known that some basic igneous rocks gave abnormal results when surveyed by the field magnetometers. Thus, for example, strikingly different curves of magnetic intensity were obtained in traverses across the Swynnerton Dyke¹ and the Lornty Dyke.² These differences seemed to be due to the magnetic polarity of the basic igneous rock (dolerite) of Lornty. Very careful measurements were made on specimens taken from accurately fixed positions in the dyke at Lornty which had been trimmed to prismatic shape with their long axes having known directions in the dyke. As was anticipated, it was proved that in this dolerite there was a fixed or inherent magnetism which, though not strong, could be accurately measured. The results have been described in a scientific paper which has been submitted for publication to the Royal Society of London.

The Survey officers who have experience in geophysical work have been consulted on several occasions during the past year by Colonial and Dominion geologists on the methods and results of geophysical explorations. At the Conference of Empire Surveyors which met in Cambridge in July, 1931, the Director of the Geological Survey gave an address on geophysical surveying which was subsequently published in the *Report of Proceedings*, 1932, pp. 90-106. Although suspended for a time, it is hoped that geophysical work has not been abandoned by the Survey, and the most recent literature is being collected and studied by the officers who are especially concerned. Assistance has been given to the Ordnance Survey who are preparing new Magnetic Maps of Great Britain and were taking observations in many parts of Scotland during the past summer. The geological information which is necessary before deciding on stations for observing the local magnetic constants has been supplied by Survey officers familiar with the districts examined and, as in previous years, close contact has been maintained with the geophysical staff of the Ordnance Survey, a relation which is obviously advantageous to both parties.

Agriculture and Forestry

Increasing use is being made of the six-inch Drift maps of the Geological Survey by soil experts, agricultural colleges and officers engaged in afforestation work. This arises in no small measure from the activities of the Soils Correlation Committee which has been working under the auspices of the Ministry of Agriculture and Fisheries and the Department of Agriculture, Scotland. On this Committee there are representatives of several

¹ 'Summary of Progress for 1929,' Part iii (*Mem. Geol. Surv.*), 1930, p. 44.

² 'Summary of Progress for 1930,' Part iii (*Mem. Geol. Surv.*), 1931, p. 24.

branches of agricultural investigation and one member of the Geological Survey, Mr. H. G. Dines. As stated in last year's *Report* (p. 24) the Committee had made a tour of selected districts in England and Wales and had drawn up a classification of British Soil Types which was founded on the nature of the 'parent material,' that is to say on the lithological and chemical character of the underlying rock masses from which the soil profile originated. The ultimate connection that subsists between 'parent material' and the geology (solid and drift) of the district is sufficiently obvious, though soils cannot be classified strictly by the geological formation on which they occur. Thus, for example, the red rocks of the Trias, the Upper Carboniferous and the Old Red Sandstone may yield soils not strikingly different: on the other hand a formation mapped as a whole by the Geological Survey, such as Boulder Clay or Bracklesham Beds, may yield several types of soils according to the various kinds of rock embraced in one geological series. A geological Drift map, consequently, cannot serve as a soil map, though it will always prove of interest and value to the soil surveyor, as a foundation for his work.

A full report of the work of this Committee up to the close of the year 1931 has been prepared for the Ministry of Agriculture and Fisheries and contains the topographical and analytical data relating to the different soil series and their profiles as recognized in England and Wales. In 1932 the work was extended to Scotland and a tour was made by representative members of the Committee from July 30 to August 10. The districts visited were around Edinburgh (the Lothians and Lammermuirs), Ayrshire, the Trossachs, Perthshire and the country near Aberdeen. A scheme has been drawn up for the soil series recognized in the districts of Scotland that were visited. The classification is based on the nature of the parent material, as in England and Wales. Of the fourteen groups into which Scottish Soil Series were classified nine were identical with types already established for England and Wales. The five additional classes are: (1) Acid igneous rocks, (2) Basic igneous rocks, (3) Serpentine, (4) Silt clays, and (5) Drifts of varied composition.

The soil specialists during this tour of investigation were accompanied by two members of the Geological Survey staff, Mr. H. G. Dines and Mr. J. B. Simpson, and also by Dr. R. Hart, of the Macaulay Institute of Soil Research, Aberdeen. The six-inch drift maps of the Geological Survey of Scotland were placed at the service of the Committee in the districts which they examined.

The soil-texture map of South Ayrshire, Sheet 14, on the scale of one inch to one mile which was referred to in last year's *Report* (p. 26) has now been published. It classifies the soils of that area into seven groups according to their physical characters, *viz.* peat; light sands, heavy sands; light, medium and heavy loams, and

clays; and is based on a very extensive series of analytical tests made by Professor McArthur of the West of Scotland Agricultural College, assisted by many collaborators. This map is supplementary to the similar map previously issued of North Ayrshire (Sheet 22) and furnishes a graphic representation of the physical types of soil over a rich and varied agricultural area covering about 400 square miles. The corresponding maps showing the 'solid' and 'drift' geology of the same area are in the press and will be published in 1933. It is very evident that there is a close correlation between the soil types and the 'drift' geology, and, where the 'drift' is thin, the solid rock also serves in large measure as parent material and determines the nature of the overlying soils. Further studies are being carried out by the agricultural experts who have participated in the preparation of these maps, such as the determination of acidity, available lime and phosphates. By this means additional definiteness and value will be given to the results of the topographical survey and a solid foundation will be laid for the scientific classification of Ayrshire soils. As a contribution to soil study or 'pedology' these maps form a notable addition to the work that is being done by British agriculturists in collaboration with geologists in the investigation of our principal soils and their regional distribution.

In June Mr. H. G. Dines visited the Pershore fruit-growing area along with Dr. T. Wallace, Assistant Director of the Long Ashton Fruit Research Station of Bristol University, in order to explain the nature of the drift deposits for the purpose of determining the best classification of the soil series already recognized in that district. Special attention was directed to the geological nature of the underlying stratum that serves as parent material and to the bearing which 'drift' maps might have on the preparation of soil maps according to the methods at present employed. The ground is not free from 'drift' though not heavily drift-covered, but as the original geological maps were prepared many years ago when the importance of drift mapping was not appreciated as it is at the present day, there are no adequate large scale drift maps of any part of the area. It was found that in a general way the distribution of the rock formations and especially of the superficial drifts was a fundamental factor in determining the soil types, but much importance had also to be assigned to deposits of a nature that is not usually taken into account in geological mapping. For example, along the sides of a valley or at the foot of an escarpment or in other situations where the ground has a definite, though not necessarily a pronounced, slope the action of rain is to accumulate fine-grained deposits, generally of the nature of rain-wash, that have great influence in modifying the characters of the soils. These superficial deposits are of great importance in intensive horticulture or fruit farming, though owing to their local distribution they are ignored or taken for granted by the geological surveyor. On small scale maps,

of course, they can hardly be represented. The result was to show that the usual type of geological map, though essential to the soil surveyor, is not sufficient in itself but should be supplemented with information that concerns the farmer more than the geologist. It would seem that the ideal method of surveying would be a combination of a geologist with a soil expert, working with special knowledge of local conditions, both geological and agricultural, on maps of a scale sufficiently large to show the distribution of soil types on areas approximating to the average field unit in the district. In recognition of these conditions the Geological Survey usually endeavours to enlist the active co-operation of the soil experts in the districts in which mapping is in progress. The work of Professor D. N. McArthur and his colleagues is a good example of this method of collaboration. The recently published memoir on the Brampton District (Sheet 18) contains analyses of a representative series of the local soils for which we are indebted to Mr. G. S. Wood of the Brampton Secondary School, and special chapters are being written for other memoirs, which are now in preparation, by agricultural advisers and others familiar with the local conditions.

In various districts of England and Wales the officers of the Forest Products Research Laboratory have had trees specially cut down in order to investigate the properties of the timber grown in these localities under the prevailing conditions. The nature of the underlying soil and rocks is one of the conditions that may influence the growth of the trees and consequently the value of the timber; and application has been made for the requisite geological information. Specimens of the rocks have been sent in for identification. In order to secure a complete record of the soil conditions, small pits are sunk to a depth of several feet to obtain samples both of the drift, or surface materials, and of the rock beneath. It is recognized that in any future schemes of afforestation those varieties of timber that grow well on the local geological formations should be given preference. The information is being filed for reference.

Shafts, Sinkings and Bores for Minerals

As in previous years one officer in England and one in Scotland is detailed to visit all mineral borings, etc., notified to us under the Mining Industry Act of 1926. Full copies of the journals are taken, and notes are added to record any peculiarities of the strata passed through that may be of value as indicating definite geological horizons. Large numbers of fossils are collected every year from the cores.

Only one boring for oil in Great Britain has been notified of recent years, and, though suspended for a time, it has been resumed and is now in progress.

Among the interesting facts acquired during the past year in Nottinghamshire is the recognition of a new marine band at Mansfield. It lies above the Deep Hard Coal and fossils from the same bed have subsequently been collected from the sinking at Bilsthorpe Colliery. At Kirkheaton, Yorkshire, three marine bands were penetrated, and one of these was apparently hitherto unknown. At Stockport, near Manchester, it was found that the Coal Measures were considerably nearer the surface than had been anticipated.

Dr. Crookall and Mr. Dines have continued to visit the new shafts and drives in the Kent Coalfield and have collected a large amount of new information regarding the fossils and geological structure of that area. It is intended to publish a selection of the more important geological data thus obtained in the second part of the *Summary of Progress* for 1932.

From a boring at Ostend M. Halet, of the Geological Survey of Belgium, has presented us with a valuable collection of specimens. These include Tertiary beds, Chalk and dark slates (possibly Silurian) which were reached at a depth of 273 metres. They are of special interest as resembling certain dark slates which were proved at the bottom of the Braybourne boring in Kent.

In England borings for water are more numerous than borings in search of coal and other minerals. In Scotland the opposite is the case as the communities mostly depend on upland water-supplies, and the coalfields are so much broken up by faults that much boring is carried on by the mining companies. Consequently the work of bore inspection in Scotland is definitely related to the development of the mining industry and demands are frequently received from borers and mining engineers for the services of geologists to interpret the records of the strata met with in borings. The active co-operation of the coal mining firms in furnishing complete journals and allowing every facility for collecting specimens is of great value to the Geological Survey, and secures that no new data of importance regarding the sequence of strata and the structure of the Scottish coalfields will escape observation and record. A few particulars gleaned from recent bores in Scotland may be added here.

From three bores put down in the Dullatur district a small suite of fossils was obtained from the thin beds of shale associated with the Huntershill Cement Limestone. Except for one record¹ from the old quarries at Coltpark and Crowhill near Glasgow no list of organic remains from this important horizon has been previously published. The fossils from the bores at Dullatur include the following forms: *Camarotoechia* sp., *Lingula* sp., *Nucula oblonga* M'Coy, *Sanguinolites* cf. *plicatus* Portl., *S. variabilis* M'Coy, *Streblopteria ornata* (R.Eth., jun.), *Bucaniospis striatus* (Flem.), and *Euphemus urei* (Flem.).

¹ Young, J., and J. Young, 'Local Unconformity as shewn in Sections at Bishopbriggs, *Trans. Geol. Soc. Glasgow*, vol. ii, 1867, pp. 289-290.

In one of the same series of bores at Dullatur a specimen of a goniatite was obtained from the beds of shale overlying the Index Limestone, and from another bore situated farther west, near Kirkintilloch, examples of goniatites have also been found near the top of the thick series of shales overlying the Orchard Limestone. The shell from the first-mentioned horizon has been identified by Mr. W. S. Bisat as a form of *Anthracoceras* and those from the latter horizon are specimens of *Anthracoceras glabrum* Bisat.

In a previous year's report¹ late forms or mutations of *Anthracoceras glabrum* Bisat were recorded from beds near the base of the Millstone Grit and from two horizons in the Upper Limestone Group. The shell from the Millstone Grit was considered to occupy a position near the top of Zone E of Mr. Bisat's classification, and on the evidence now available it is probable that the higher division of the zone must also include the beds overlying the Index Limestone if not the limestone itself.

A boring recently completed in East Lothian has provided from the district the second record of the shelly marine horizon that has been correlated with the Johnstone Shell-bed of Renfrewshire. In common with other occurrences of this important horizon, including the previous record from East Lothian, the shell-bed was found in two leaves, and the fossils obtained include the following characteristic forms: *Productus* sp., *Ctenodonta laevirostris* (Portl.), *C. undulatus* ? (Phill.), *Nuculana attenuata* (Flem.), *Streblopteria ornata* (R.Eth., jun.) and *Euphemus urei* (Flem.).

Building Stones Research

The joint investigation into the properties of British building stones that is being carried on with the officers of the Building Research Station is at present concerned with the oolitic Secondary limestones, especially Portland Stone and others of similar type, and with the magnesian limestones, such as Anston.

A new field of interest has been opened up, however, by the discovery that certain slates have properties that may make them useful in directions hitherto unexplored. In order to obtain specimens suitable for the investigation a joint tour was made by Dr. T. Neville George of the Geological Survey and Mr. E. H. Coleman of the Building Research Station. They visited a number of slate quarries in different parts of Wales and collected many specimens, besides making notes on the geological horizons and the physical properties of the slates of each district. This is intended to furnish a basis for further experimental work, and if possible to elucidate the reasons for the divergences observed in the slate specimens which have been tested in the laboratory. The subject is one which calls for a close co-operation of petrological, chemical, geological and experimental methods of research.

¹ 'Summary of Progress for 1930,' Part i (*Mem. Geol. Surv.*), 1931, pp. 23-24.

Fuel Research

On all the district committees of the Fuel Research Station which advise on the investigation of local fuels there is a representative of the Geological Survey. His duties are to furnish geological information relating to the various researches in hand and to secure effective collaboration with the fuel experts, chemists and others who conduct the work. The Survey officers in question are :—

Scotland	...	...	...	...Dr. Murray Macgregor
Northumberland and Durham				Mr. R. G. Carruthers
Yorkshire	...	...	...	...Mr. C. E. N. Bromehead
Nottinghamshire		...	...	...Mr. C. E. N. Bromehead
Lancashire	...	...	...	...Dr. W. B. Wright
North Staffordshire		...	...	...Dr. B. Smith
Forest of Dean	...	...	...	...Dr. R. W. Pocock
South Wales	...	...	...	...Mr. E. E. L. Dixon

Similarly when questions are raised regarding the properties of fuels, or chemical tests are required, the services of the officers of the Fuel Research Station have been freely provided.

Conferences

At the International Congress of Prehistoric and Protohistoric Sciences held in London in August Mr. Dewey delivered a lecture and conducted an excursion to the well-known gravel pits of Swanscombe which contain palaeolithic implements.

The British Association meeting was held in York and Mr. Bromehead gave a lecture on the geology of the district. A special exhibit of maps, memoirs and photographs by the Geological Survey attracted much attention. Several Survey geologists also conducted excursion parties to various localities.

At the *Conversazione* of the Geologists' Association in London in November a new model showing the geology of the Weald district was exhibited, accompanied by maps and photographs.

In July the Director attended a meeting of a Committee appointed by the Institut International de Co-opération Intellectuelle under the auspices of the League of Nations to consider the organization of Scientific Museums.

An exhibit of maps and memoirs on the geology of Lancashire was provided for an evening meeting under the auspices of the Committee of Associated Learned Societies of Liverpool and District.

Accommodation

No alterations have been made in the Museum and London offices owing to the impending removal. At York a new and more

satisfactory office at 32, St. Mary's has been provided, and the staff and documents were transferred in July. In the Edinburgh offices one of the two rooms now occupied by the library and the collection of photographic albums has been equipped with modern steel shelving by H.M. Office of Works.

Palaeontology

ENGLAND AND WALES.—The fossils received during the year numbered 5,364 specimens, of which 1,323 were obtained by presentation. These donations included a valuable collection of Lower Palaeozoic fossils from Gloucestershire and from Irish localities, received from Professor S. H. Reynolds, and a series of zonally collected specimens from various localities and formations, chiefly Cretaceous, the gift of Mr. W. Wright. Miss M. S. Johnston permitted the selection of a further set of fossils of a miscellaneous character from her collection. Type-specimens and other fossils from Carboniferous horizons were received from Mr. W. S. Bisat, and from Drs. R. G. S. Hudson, T. N. George, and Stanley Smith. Dr. Stanley Smith also presented a choice collection representative of the Tremadoc fauna of the Breadstone shaft, near Berkeley Road, Gloucestershire. Other presentations of fossils received during the year are noted in the List of Donations on pp. 33-36.

An increasing amount of time has been spent by all members of the staff of the Palaeontological Department in selecting specimens and arranging them to form parts of the new exhibits illustrating the regional geology of England and Wales. The work of preparing these exhibits has involved the consideration of many technical details of display and labelling. To a large extent the stored collections, not hitherto exhibited, have been drawn upon for the appropriate specimens; a certain amount of new collecting has also been found to be necessary, and this has been duly undertaken.

Dr. Kitchin devoted considerable time to matters of detail connected with the new exhibits, taking part in many consultations, in addition to carrying on work of an editorial and supervisory character. He selected and arranged a series of specimens illustrating the concealed formations from the Silurian up to the Corallian in the county of Kent, as a contribution to the Weald regional display to be shown in the new Museum. He also contributed to the arrangement of cases in the London and Thames regional exhibit, in course of preparation.

In the course of his work on specimens collected for the purposes of current surveying, Mr. C. P. Chatwin named a large series of Permian fossils from the area of Sheet 87 (Barnsley) and a set of Cretaceous fossils from Sheet 287 (Sevenoaks). Among other material dealt with was a series of derived Jurassic fossils found in the Lower Greensand of Sandy, Bedfordshire, and a set of core-samples from the Cretaceous beds of the Westwood boring,

Surrey. Mr. Chatwin continued the work of collating specimens in the Geological Society's Collection, previous to their registration by Miss Odell. He also assisted in preparing the manuscript of the Cirencester Memoir for the press, and in revising the proofs of the Torquay Memoir. Much of his time, however, has been occupied in work connected with the new Museum. He selected a representative series of fossils to illustrate the Pliocene System in the new Stratigraphical Collection, and made a survey of material needed for the regional exhibit of East Anglia, the necessary collecting being carried out by Mr. Dewar. With the assistance of Mr. Hester he made considerable progress in the selection and arrangement of exhibits illustrative of the geology of the Hampshire Basin district.

Dr. C. J. Stubblefield devoted much time to the selection, naming, and labelling of various fossils from the Cambrian, Ordovician, Silurian, and Carboniferous systems, suitable for certain of the regional exhibits in the new Museum, and also some Ordovician fossils for the more detailed stratigraphical and zonal exhibition. He identified many fossils collected during current Survey mapping from the Ordovician and Carboniferous strata in Sheet 23 (Cockermouth), and from the Carboniferous rocks in Sheets 37 (Gosforth), 86 (Glossop) and 167 (Dudley), and in the Kent Coalfield. He also collated the collection of Lower Palaeozoic fossils received from Professor S. H. Reynolds, prior to its registration.

Miss M. E. Odell has continued her registration work, dealing with current acquisitions and overtaking some of the arrears. She has made satisfactory progress with the registration of specimens in the Geological Society's Collection.

The effort was made to restrict, as far as possible, the fossil-collecting normally undertaken in connexion with current geological mapping, in order to utilize the services of the technical staff in preparing exhibits for the new Museum. In addition to making short visits to localities in Surrey and to the site of a boring near Brighton, in order to examine and collect from Cretaceous rocks, Mr. S. W. Hester carried out some systematic collecting in the neighbourhood of Bridport and other localities in Dorset. He obtained a series of Jurassic rock-specimens and fossils suitable for use in the arrangement of cases forming part of the new Hampshire Basin regional exhibit. His indoor work included the reorganization of stored collections, the preparation of synoptic fossil-lists for use in memoir-writing, and numerous contributions to the regional exhibits by the selection of suitable specimens and the preparation of mounts, diagrams, and labels.

Mr. W. Dewar collected fossils in the areas of Sheets 287 (Sevenoaks) and 203 (Bedford). He also spent a month in collecting rock-specimens and fossils from various formations in Bedfordshire, Huntingdonshire, and the counties east of this to the coast. The specimens obtained were for the purpose of one of the exhibits of regional geology: that of East Anglia and some

neighbouring counties. He visited the site of a well-sinking near Long Stanton, N.W. of Cambridge, noting the section and obtaining a collection of fossils and rock-specimens from the clays passed through. He re-arranged the thousands of specimens in the Museum reserve collection of fossils and added much information to the registers, also carrying out a considerable amount of work on the permanent reference-collection of Survey fossils. He prepared synoptic lists of fossils for utilization in memoirs, and also gave assistance by the determination of freshwater molluscs from the Coal Measures of various localities. Mr. Dewar also contributed to a number of the regional exhibits by selecting the necessary specimens of rocks and fossils and carrying out the technical work connected with their display.

Mr. S. W. Morgan has been much occupied in assisting research workers and in sending out specimens lent for the purposes of study. He has also been engaged in preparation-work on specimens for exhibition, in the registration of specimens, and in other technical work connected with new exhibits. Other items done by him included the preparation of records of type-specimens and the reorganization of parts of the Survey reference-collection of fossils. The number of specimens sent out on loan during the year was 1,277.

Numerous enquiries were dealt with in the course of the year, and research workers were assisted at the Museum and by correspondence, as well as by the loan of material.

SCOTLAND. — Nearly 1,300 specimens of fossils were obtained during the year, and added to the Survey reference-collection in Edinburgh. About half of the total is represented by material obtained from borings and sinkings in the Carboniferous rocks of Ayrshire, Fife and Midlothian, and in the Carboniferous and Permian strata of Northumberland and Durham. The remaining specimens were collected during the revision of the Sanquhar Coal-field and the mapping of the Coal Measures of the Thornhill basin. In addition, numerous specimens, chiefly rocks, were obtained at certain localities in the north of England and in the south of Scotland for the purpose of exhibition in the new Museum in London. The collection of the material was carried out by Messrs. Manson, Eckford and Fisher. Mr. D. Tait collected a representative set of arctic plants and associated animal remains from peaty layers exposed in recent excavations made on the site of the old Corstorphine Loch.

The Carboniferous specimens collected have been examined by Dr. J. Pringle, who has had occasional help from Professor A. E. Trueman in the identification of species of molluscs from the Coal Measures. The arctic plants were kindly identified by Professor T. Johnson.

Considerable progress has been made by Mr. E. M. Anderson in registering the John Smith Collection, 12,500 specimens having now been numbered and entered in the departmental registers. Mr.

SUMMARY OF PROGRESS :

Anderson has also prepared a card-index of localities. The registration of the Geological Survey collection of fossils exhibited in the Royal Scottish Museum has been completed.

Numerous requests for the loan of material for study were made during the year by workers engaged in research, and more than 1,600 specimens were sent out to approved borrowers.

Palaeobotany

The Palaeobotanist has identified fossil plants from the areas covered by twelve one-inch sheets, namely, Sheets 8 (Elsdon), 9 (Rothbury), 10 (Woodhorn), 15 (Tynemouth), 23 (Cockermouth), 26 (Wolsingham), 84 (Wigan), 87 (Barnsley), 167 (Dudley), 273 (Faversham), 289 (Canterbury) and 290 (Dover).

He has made two visits to the Kent Coalfield and one to the Bristol and Somerset Coalfield, and has prepared accounts of the palaeobotany of the Kent Coalfield and of the Lancashire Coalfield.

The chief items of work have been concerned with the preparation of exhibits for the new Museum. Considerable work has been done on the Coal Exhibit which now approaches completion. The regional exhibit and the descriptive account of the Bristol and Gloucester district is in hand, and assistance has been given by Dr. F. B. A. Welch. The Palaeobotanist has furnished fossil plants for those regional exhibits which include Coal Measures, etc.

Twelve negatives of selected specimens have been made of fossil plants from the Kent Coalfield: these include new species. Six slides of *Cheirostrobis pettycurensis* have been purchased from Mr. Hemingway, of Derby, as well as nine syntypes of species of *Sphenophyllum*.

Among the noteworthy presentations to the Museum is a large portion of a fossilized tree-trunk, presented by T. Matthews, Esq., per H. Lapworth, Esq. This was found three miles west of Coventry in a boring for water at a depth of 242 ft. (i.e. in the upper part of the Corley Group — above the Keele Beds in the Upper Coal Measures). It may be noted that silicified stems are known from these beds at Allesley and Meriden, and are recorded in the Coventry Memoir (1923, p. 87).

Petrography

During the past year the work of the Petrographical Department has been, apart from ordinary routine, mainly concerned with the collections. It has been found necessary to register and re-register much of the existing material and to supplement it by fresh collection. The work of registration of museum specimens has occupied Miss E. M. Guppy since April of last year. Nine thousand specimens have been registered, and as far as possible their history recorded. The material dealt with includes all that at present on exhibition, most of the newly collected specimens,

and valuable collections from the petrographical stores. Earlier in the year Miss Guppy assisted the Petrographer in the preparation of an exhibit to illustrate the rock-forming minerals.

Mr. T. G. Jones was engaged for a considerable period in the summer collecting representative museum specimens, to the number of 571, from the older rock-formations of the Lley Peninsula, Cader Idris, Aberystwyth, Snowdonia and the Bangor district, Llandovery, Rhyader and Builth, Kington and Woolhope, and the Malvern and Clee Hills.

Dr. T. N. George, in co-operation with officers from the Building Research Station, visited most of the important Welsh slate quarries and collected 183 specimens for the Museum, mainly from the counties of Pembrokeshire, Carnarvonshire, Merionethshire, and Denbighshire. Later in the year he collected 150 sedimentary and igneous rocks from the counties of Monmouthshire, Worcestershire and Shropshire to supplement the existing collections.

Similar collections have been made for museum purposes by other field officers, namely : Dr. Welch, 29 from the southern counties; Dr. Pocock, 5 from the Wrekin, etc.; Mr. Buchan, 20 from Surrey and Kent; Mr. Eastwood, 24 from the Lake District; Dr. Sherlock, 37 from the Jurassic and Cretaceous rocks of Oxfordshire and adjoining counties; Mr. Rose, 22 from the Isle of Man and Lake District; and Mr. Edmunds, 28 from East Anglia. Thus, additions of more than 1,000 specimens have been made to the English and Welsh rock-collections.

Mr. Andrews and Mr. Hepple, in addition to their work on the preparation of rock sections, have completely overhauled and cleaned the collections of sliced rocks, repairing or replacing damaged or missing sections as far as was possible. The collections are now in a most satisfactory condition and ready for their removal to the new Museum. Much work has also been done on the petrographical stores. Valuable material has been put aside for registration, and the remainder reviewed and put in order preparatory to removal.

Much of the Petrographer's time has been occupied with matters connected with the equipment of the new Museum and prospective exhibits, but the Department has as usual been freely consulted by Government Departments and public bodies. During the year the memoir on the geology of the Cheviot Hills, containing an account of the petrography of the granite and lavas of the region, was published.

The number of sliced rock-specimens and corresponding sections registered in the collections and housed for reference in the Petrographical Department in London, is as follows :—

English and Welsh	...	...	...	...	16,326
Scottish	...	...	...	...	29,526
Irish	...	...	...	...	458
Foreign	...	...	...	...	3,368

Total 49,678

SUMMARY OF PROGRESS :

This represents an aggregate increase of 1,426 in the registered sliced specimens during the past year. Of the corresponding sections 723 were made by Messrs. Andrews and Hepple in the London office, and 214 were registered to be made in Scotland, 937 in all. Of the remaining 489, presentation accounted for 347 and purchase for 142. The presentations included 156 rocks and sections from the collection of the late Dr. Horne, and 176 rocks and sections from the Director of the Building Research Station.

During the year 1,136 sections and 277 rocks from the collections were dispatched to various Survey officers in Scotland and elsewhere for study, while 267 sections and 9 rocks have been loaned for like purpose to private individuals.

Photography

Owing to the prospective requirements of the new Museum it has been found necessary to obtain photographs of geological interest from districts hitherto unillustrated and to supplement the existing collections in certain respects. With this object Mr. Rhodes visited the districts of King's Lynn, the Hampshire Basin, Bridport, North Cornwall, Devon and Somerset, and Pembroke-shire, taking in all 423 views.

The indoor work carried out by Mr. Rhodes and Mr. Radley has been the making of 218 sepia-toned enlargements (24 in. by 18 in.) for exhibition in the Museum, and others to the number of 134, of which 60 were made in compliance with orders from the public.

Lantern-slides have been made to the number of 420, of which 314 were for official use and 106 were outside orders. Contact prints to the total of 1,900 have been made from Survey negatives, of which 934 were for the Survey albums, 402 for Museum exhibits, 20 for reproduction in Survey publications, and 544 as outside orders from the public.

Prints and their corresponding descriptive forms to the number of 428 have been mounted in the Survey reference albums, and 148 miscellaneous prints have been mounted for various purposes.

The number of negatives now registered is as follows :—

English photographs	...	...	...	...	6,157
Photomicrographs	...	...	...	...	2,158
Miscellaneous photographs	...	...	...	...	2,528
Total					10,843

Chemistry

The number of analyses registered in this Department's records at the end of 1932 is as follows :—

England	...	...	...	...	...	358
Scotland	...	...	...	...	...	571
Ireland	...	...	...	...	...	2
Wales	...	...	...	...	...	55
Others	...	...	...	...	...	52
Total						1,038

Twenty-one of these analyses have been completed during the year and six are still in progress. Twenty-three qualitative analyses have been carried out for Survey officers, and numerous enquiries have been dealt with. Final details of the installations and fittings required in the laboratory of the new Museum have been worked out.

Museum of Practical Geology

The Museum officers have been occupied almost entirely with the preparation of the exhibited collections for the new building at South Kensington. The services of two geologists, Mr. V. A. Eyles and Dr. W. Q. Kennedy, have been requisitioned for assistance with the work, and steady progress has been made with the preparation of the introductory exhibits and the displays of economic rocks and minerals, designed respectively for the ground floor and second gallery of the new Museum. In this connexion a scheme for printing labels, drawn up with the help of H.M. Stationery Office, is now in operation.

The final details of the furniture and equipment necessary for the new galleries and offices have been settled with H.M. Office of Works, and a considerable proportion will shortly be ready for delivery.

The Library has received its normal accessions, and continues to be used to a gratifying extent by the public, students, and research workers. In addition to normal duties the staff has been engaged on plans for the lay-out of the new library and preparations for the orderly removal thereto of the large collections of books, pamphlets and maps at present housed here.

LIST OF DONATIONS DURING THE YEAR 1932

- ALLSEBROOK, G., AND CO.—Series of about 50 Tertiary and Chalk specimens from a recent boring at Whitway, Hampshire.
- ANGLO-PERSIAN OIL CO., LTD.—Rocks from Persian Oilfield.
- ASHMORE, G. P., ESQ., A.R.S.M., M.INST.M.M.—Diamondiferous gravel and bedrock from Atankama and Kokotenten, W. Africa.
- BARNARD, G. P., ESQ., A.INST.M.M., F.G.S.—Kipushite from Kipushi, Katanga.
- BISAT, W. S., ESQ., F.G.S.—Type-specimens and paratypes of Cephalopoda from the Millstone Grit of Lancashire and Yorkshire, including species of *Cravenoceras* and *Reticuloceras*; and two figured specimens of *Solenocheilus cyclostomus* (Phillips), from the Millstone Grit of Yorkshire.
- BORAX CONSOLIDATED, LTD.—Pandermite from Panderma, Asia Minor.
- BRANSON, J. M., ESQ. (*per* Dr. R. G. S. Hudson, F.G.S.).—The type-specimen of *Cravenoceras subplicatum* Bisat, from the Millstone Grit of Yorkshire.
- BRICK, M. F., ESQ., B.A.—A series of Graptolites from the Lower Llandovery of Coal Pit Bay, Co. Down, Ireland.
- BRISTOL MUSEUM AND ART GALLERY, THE DIRECTOR OF.—Four specimens of fossil fishes from the Old Red Sandstone of Woodhill Bay, Portishead, Somerset.

- BROMEHEAD, C. E. N., Esq., B.A., F.G.S.—A footprint of a Deinosaur from the Upper Estuarine Beds of Yorkshire.
- CHERRY, J., Esq. (*per* W. S. Bisat, Esq., F.G.S.)—Paratypes of *Cravenoceras cowlingense* Bisat, from erratic block in Keighley Churchyard, Yorkshire.
- DAVIES, PROFESSOR A. MORLEY, Esq., D.Sc., A.R.C.S., F.G.S.—A specimen of *Sphaerophthalmus alatus* (Boeck), from the Upper Cambrian (Whiteleaved Oak Shales), near Malvern, Worcestershire.
- DRUGMAN, JULIEN LÉON EUGÈNE, Dr. phil., Collaborateur extérieur Mus. R. d'Hist. Nat., Uccle-Bruxelles, Belgium.—Set of seven quartz twins from the Belowda Clay Pit, Cornwall.
- EDMONDS, C., Esq., J.P. (*per* Dr. Stanley Smith, M.A., F.G.S.)—A specimen of *Labechia carbonaria* S. Smith, from the Carboniferous Seventh Limestone of Frizington Parks, West Cumberland.
- FARRE-BULLE, J. A., Esq.—A distorted crystal of topaz.
- FLANDERS, MISS M.—Seven specimens of *Gastrioceras* from the roof of the Alton Coal at Ambergate Junction, Derbyshire.
- FOWLER, MAJOR GORDON, R.A.—Bone of Deer from the Peat of Wiggshall St. German, Norfolk.
- FRIEDLÄNDER, DR. IMMANUEL, Leiter Vulkaninst. Imm. Friedländer, Napoli-Vomero, Italy.—A set of eruptive rocks.
- GEORGE, T. N., Esq., M.Sc., Ph.D., F.G.S.—A series of Goniatites from the Millstone Grit of Parcgyllt Reservoir, Glamorgan; and a series of marine shells from the Quaternary beaches of Gower, Glamorganshire.
- GRUMMIT, W. G., Esq.—Six rock specimens from northern Nigeria.
- GRUNER, PROFESSOR J. W., Univ. of Minnesota, Minn. Geol. Survey, Minneapolis, Minn., U.S.A.—Specimens of iron ore from Minnesota.
- HADDING, DR. R.A.—Ironstone from Scania, Sweden.
- HOBLEY, C. W., Esq., C.M.G., A.M.Inst.C.E., F.G.S.—An example of *Clydoniceras* from the Cornbrash of the Great Western Railway cutting at Frome, Somerset; and a series of Upper Cambrian Trilobites from the Nuneaton district.
- HOLMAN, PROFESSOR B. W.—Cassiterite with lepidolite from near Lake Tanganyika.
- HUDSON, DR. R.G.S., F.G.S., and W. S. BISAT, Esq., F.G.S.—Holotypes and paratypes of *Cravenoceras cowlingense* Bisat and *Cravenoceras stellarum* Bisat, from the Millstone Grit of Yorkshire.
- HUDSON, DR. R.G.S., F.G.S.—A series of Brachiopoda, including the type-specimen of *Schizophoria hudsoni* T. N. George, from the Millstone Grit of Yorkshire; also type-specimens of *Cravenoceras* from the Millstone Grit of Lancashire and Yorkshire.
- JACK, G. H., Esq., F.S.A., M.Inst.C.E., F.R.I.B.A., F.G.S.—Four specimens of ventral shields of *Pteraspis rostrata* (Agassiz), from the Lower Old Red Sandstone (Cornstones) near Newton, West Herefordshire; a portion of cephalothorax of *Pterygotus* sp., from the Lower Old Red Sandstone of Longtown, Herefordshire; and a spine of *Ctenacanthus* sp., in dolomite, from the upper part of the Carboniferous Limestone series at Drybrook, Gloucestershire.
- JEFFREY, J. L., Esq.—An example of *Nautilus pseudoelegans* d'Orbigny, from the Kentish Rag of Allington, near Maidstone, Kent; and of *Ostrea bellovacensis* Lamarck, from the Woolwich Beds of Epsom, Surrey.
- JOHNSTON, MISS M.S., F.G.S., F.R.G.S., F.Z.S.—A series of fossils from various horizons and localities, selected from her cabinets.

- JONES, F., ESQ.—A series of fish teeth from the Woolwich Beds of Abbey Wood, Kent.
- KELLIER, ALEXANDER, ESQ.—One specimen of andalusite-schist and one of mica-schist from Glen Mor, Morven, Aberdeen.
- KENDAL, J. D., ESQ. (bequeathed by).—A series of minerals from Cumberland.
- KING, PROFESSOR W. B. R., O.B.E., M.A., F.G.S.—Six choice Ordovician and Silurian fossils from the Lake District.
- KUP, C., ESQ.—Minerals from the Morro Velho Gold Mine, Minas Geraes, Brazil.
- LANG, PROFESSOR W. H., M.B., D.Sc., F.R.S.—Four microscopic slides of *Dadoxylon hendriksi* W. H. Lang, cut from material collected by Miss E. M. Lind Hendriks, Ph.D., in South Cornwall.
- LEACH, A. L., ESQ., F.G.S.—A series of fossils from the Coal Measures and Millstone Grit of Pembrokeshire.
- MANSFELD, A. G. (Aktiengesellschaft für Bergbau und Hüttenbetrieb), Eisleben, Germany.—Specimens illustrating the occurrence of Kupferschiefer at Mansfeld.
- MIDDLETON MINING CO., LTD.—Lead ore and spar-breccia from Middleton-by-Youlgrave.
- MURRAY, R. B., ESQ.—Mineral specimens (various).
- NATIONAL GEOGRAPHICAL SOCIETY, WASHINGTON, D.C., U.S.A.—Six photographic enlargements of volcanic phenomena.
- OSBORNE, DR. G. D., Univ. of Sydney, N.S.W., Australia.—Five rock specimens from Grange, Co. Down, Ireland; and two from the Island of Utö, Sweden.
- REYNOLDS, PROFESSOR S. H., M.A., Sc.D., F.G.S.—A series of fossils illustrating his papers on the Lower Palaeozoic stratigraphy of Gloucestershire and various parts of Ireland.
- SCRIVENOR, J. B., ESQ., I.S.O., M.A.—Three rock specimens from Malaya.
- SCRUBY, H. MORTLOCK, ESQ.—Six specimens of cassiterite and one rock specimen from Nigeria.
- SEDGWICK MUSEUM, CAMBRIDGE.—A specimen of *Phillipsinella parabola* (Barrande), from the Ashgill Series of Torver Beck, Coniston, Lancashire; also four specimens of *Astarte obliquata* J. Sowerby, from the Coralline Crag (Boytonian) of Boyton, Suffolk.
- SHEPHERD, W., ESQ.—Two large specimens of *Ostrea* sp., from the Bracklesham Beds near Christchurch, Hampshire.
- SIMPSON, H. H., ESQ., B.Sc.—Spine of *Gyracanthus* sp. and freshwater Lamellibranchs from the Upper and Middle Coal Measures of Denbighshire.
- SMITH, DR. STANLEY, M.A., F.G.S.—A toptype of *Aulina rotiformis* S. Smith, from the Harlow Hill Limestone of Harlow Hill, Northumberland; and a choice collection of specimens representative of the Tremadoc fauna of the Breadstone shaft, near Berkeley Road, Gloucestershire.
- SOUTH WEST AFRICA CO., LTD.—Specimen of descloizite in matrix from Uitsab, South West Africa.
- SPENCER, DR. W. K., M.A., F.R.S., F.G.S.—Five artificial casts of Starfish from the Arenig of Ramsey Island, including reproductions of figured specimens.
- ST. JOHN DEL REY MINING CO., LTD.—Specimens of gold ore from Morro Velho, Minas Geraes, Brazil.

- STONE COURT BALLAST CO. (*per* the late Mr. H. Coulter).—Teeth and bone of *Elephas* from the 100-ft. Terrace Gravels at Barnfield Pit, Milton Street, Swanscombe, Kent.
- TAYLOR, MESSRS. JOHN, AND SONS.—Specimens from the Kolar Goldfield, Madras.
- TONKS, L. H., ESQ., M.Sc., F.G.S. (*per* Dr. R. G. S. Hudson, F.G.S.).—The type-specimen of *Cravenoceras nititoides* Bisat, from the Millstone Grit of Pace Gate Beck, Yorkshire.
- TORQUAY NATURAL HISTORY SOCIETY (*per* A. H. Ogilvie, Esq.).—Specimens of rocks and casts of flint implements from Kent's Cavern, Torquay.
- TWICKENHAM GRAVEL CO., LTD. (*per* F. Williams, Esq.).—Granite boulder, mammoth tusk, teeth and bones.
- WALTON, J., ESQ.—Two specimens from below the Better Bed Coal, Lower Coal Measures, of Yorkshire, containing freshwater Lamellibranchs.
- WILLIAMS, MRS. GEOFFREY H.—One cut cairngorm (from brooch).
- WILLIAMSON, DR. GEORGE.—Series of specimens illustrating occurrence of rock salt at Sevljus, Ruthenia, Czecho-Slovakia, and two specimens of cryolite from Greenland; specimen of enhydros; series of 42 foreign gums; hatchettite from Savigno, Italy.
- WRIGHT, W., ESQ., F.G.S.—A series of zonally collected fossils from various formations and localities, chiefly Cretaceous.
- YOUNG, MRS. W. PLOMER.—An Ammonite associated with *Nautilus*, from the Lower Lias of Lyme Regis, Dorset.

JOHN S. FLETT,
Director.

II. DISTRICT REPORTS

(A)—ENGLAND AND WALES

1. SOUTHERN DISTRICT

HENRY DEWEY, District Geologist.

H. G. DINES, A.R.S.M., A.M.INST.C.E., Senior Geologist.

W. LLOYD, B.Sc.

F. H. EDMUNDS, M.A.

S. BUCHAN, B.Sc.

F. B. A. WELCH, B.Sc., Ph.D.

} Geologists.

SEVENOAKS SHEET

FOR reasons already stated (p. 5) field work was restricted, but a small area in the Sevenoaks Sheet (287) was surveyed by Messrs. Dines and Buchan during the autumn, and approximately half of that Sheet has been completed.

Wealden Beds.—Mr. Buchan has observed, at different horizons in the Weald Clay, beds of sand and of sandstone. Paludina limestone was formerly worked, west of Edenbridge, on an extensive scale for lime making, but although fragments of limestone lie near the old pits the outcrops are almost completely obscured.

Lower Greensand.—Mr. Dines has found that although the Sandgate Beds are not represented on the old geological map, Sheet 6, red, glauconitic loams are present throughout this district. In thickness they vary from ten feet to twenty-five feet: clayey sand or sandy clay comprises their normal development and most beds contain much glauconite. The regional dip of the Lower Greensand beds approximates to north-north-west, while series of sharp folds affect them on the dip-slope. Fitton¹ described a 'ridge or saddle' as extending from Montreal Park, Sevenoaks, through Sundridge to Brasted Place. The fold so described forms one of the series of sharp anticlines and synclines that trend nearly parallel to the strike, the most persistent member of which may be coterminous eastward with those of Knole Park described in last year's *Summary of Progress* (Part i, p. 39). A parallel series lying at a distance of half to three-quarters of a mile farther south has been traced from near the Sevenoaks railway-cutting to Manor Farm, south of Sundridge.² At Dryhill a branch fold is thrown

¹ *Trans. Geol. Soc.*, ser. ii, vol. iv, 1836, pp. 133-136.

² Fitton also observes that the strata are disturbed at Manor Farm, *op. cit.*, p. 135, footnote.

off from the Sevenoaks-Brasted line of folds and trends north-west by west under Sundridge into the grounds of Combe Bank, while another small, east-and-west, saddle-fold has been traced about midway between Sevenoaks Station and Bradbourne Halt.

Chalk.—Mr. Edmunds revised the boundary lines of the divisions of the Chalk in the area of Poynings, Sussex (Sheet 318). Evidence derived from a bore for water put down by the Brighton Corporation Waterworks proved that revision was necessary.

Pleistocene.—Mr. Dines, during his survey of the Lower Greensand beds south of Sevenoaks, observed an angular chert drift, forming a structureless mass of chert and hassock rubble in a matrix of fine loamy sand, which he has been able to map. The materials, although mainly derived from the Hythe Beds, include clayey, variegated loams from the Sandgate clays. The deposit locally attains a thickness of ten feet along the crest of the escarpment, but thins northward down the dip-slope of the Hythe Beds and in places oversteps on to the Sandgate Beds. It exhibits some characteristics of glacial deposits such as festoons, and the absence of regular bedding; and its mode of occurrence suggests an origin similar to that of the Clay-with-flints of the Chalk outcrop.

Mr. Buchan observed on the Weald Clay some spreads of gravel; the constituents were rolled flints, usually brown, blue flint pebbles and small fragments of materials from the Lower Greensand.

BRIDPORT SHEET

During the spring Dr. F. B. A. Welch was transferred to Beaminster to co-operate with Mr. W. Lloyd in the continuance of the survey of the Bridport Sheet (327); and in the autumn Mr. Buchan also joined the Dorset unit.

Middle Lias.—The local subdivisions of the Middle Lias in descending order are: (3) the Thorncombe Sands¹; (2) the Down Cliff Sands¹; (1) the Eype Clay.² Mr. Lloyd finds that the Eype Clay is well displayed in the coast section at Eype Mouth. Inland the Sands have not yet been separated on the map, although the Down Cliff Sands may be distinguished by their pronounced lamination. The Eype Clay, not shown on the old map, has been traced inland: its top beds generally form irregular 'rushy' ground, separated from the Sands by a well-marked line of 'soak'.

Dr. Welch and Mr. Buchan note that a series of sands, with layers of doggers, lies below the Marlstone Rock. The lower part of these sands shows conspicuous laminations which are absent from the higher part. Buckman³ chose as a line of separation a

¹ See Buckman, S. S., 'Jurassic Chronology, II,' *Quart. Journ. Geol. Soc.*, vol. lxxviii, 1922, p. 382.

² The term Eype Clay is proposed to designate the sandy clays at the base of the Middle Lias.

³ *Op. cit.*, p. 382.

bed of limestone (Margaritatus Bed) associated with a thin band of clay. Inland separation was not made, since the Margaritatus Bed has not been detected. Below the sand, thick sandy clay (Eype Clay) occurs, which at the coast is capped by the Starfish Bed. Though this bed has not been found inland, nodules of sandy limestone containing small gastropods occur at the top and form a useful datum line. The nodules may be the equivalent of Day's 'Shell Bed' of the coast.

The Eype Clay contains many small ammonites of the *Amaltheus* type. A very strong line of springs is thrown out at the junction of the clays and sands. The Middle Lias inland is everywhere capped by the Marlstone Rock which may be of two lithological types: (1) a fine-grained, brownish, finely ironshot rock; (2) bluish, coarsely crystalline limestone. At all localities where the Middle Lias occurs it is immediately overlain by a thin deposit of dull white, lithographic limestone, with local marl and clay partings and containing many rolled Upper Lias ammonites. This deposit is the equivalent of Buckman's² 'Junction Bed' of the coast sections. The Junction Bed and the Marlstone Rock together give rise to many of the characteristic low flat-topped elevations of the Lias country, as around Bradpole where they cap the ridge of Middle Lias Sands, along the crest of which runs the main road from Bridport to Beaminster.

Mr. Lloyd remarks of the Junction Bed that it forms the chief feature of interest, although only a few feet thick. Its distinctive lithology, a white lithographic limestone, easily leads to its recognition in arable land and chiefly by this means it has been traced into the Bradpole, Symondsbury and Walditch districts. The exposures at Red Cross and Dodham's Lane, Bradpole; Shipton Lane, Bothenhampton; and Shute's Lane and Warren House Lane, Symondsbury, are poor and so overgrown that no faunal comparison can be made with the long sequence of ammonite types of the coast.³

Upper Lias.—The Bridport Sands have been mapped along the coast and inland. Mr. Lloyd states that east-and-west faults are predominant in the Bridport district and the tracing of them has led to modifications of the Old Series one-inch map. A big fault which throws down the Lias east of Eype Mouth has been found to be continuous with the one ranging east-to-west through Bothenhampton and bringing Cornbrash and Junction Bed in juxtaposition; the downthrow to the south being about 550 ft.

Fullers' Earth.—Dr. Welch, in examining stream sections near Meerhay, north of Beaminster, found bands of indurated marl and limestone occurring towards the middle of the series, and yielding abundant brachiopods. These are the representatives of

¹ *Quart. Journ. Geol. Soc.*, vol. xix, 1863, p. 288.

² *Op. cit.*

³ See Buckman, S. S., 'Jurassic Chronology, II,' *Quart. Journ. Geol. Soc.*, vol. lxxviii, 1922, p. 378.

Buckman's¹ Brachiopod Beds of Watton Cliff. The following appears to be the descending order of succession :—

3. Ornithella Bed, with large *Rhynchonella* ? *smithi*,
2. Acanthothyris Bed,
1. ' *Terebratula globata* ' Bed, with small crushed *Rhynchonella smithi*, *Modiola*, *Trigonia*, and an ammonite.

The same succession has been found north of Wynford Wood near Toller Fratrum, but the sequence appears more condensed and limestone bands are not well developed.

Forest Marble.—This formation is but poorly exposed. The basal *Goniorhynchia boueti* Bed described in the *Summary of Progress for 1931*, Part i, p. 40, has been observed north of Beaminster, and also north of the Chalk ridge near Corscombe (Sheet 312).

Oxford Clay.—This clay has been seen only in the region of Benville, near Rampisham, and Chelborough (Sheet 312) and consists of tough blue shale with limestone nodules full of *Nucula* and ammonites. Mr. Lloyd has mapped a small area east of Bothenhampton.

Gault.—Messrs. Welch and Buchan observed that, although no Gault is indicated on the Old Series map, everywhere beneath the beds of the Greensand, Gault clay occurs. The proving of its presence, however, involved hard and tedious use of the hand auger, and upwards of 650 boreholes were sunk. The Gault is some 30 to 40 feet thick, and consists of blue, micaceous, clayey silt which is lithologically identical with the Gault exposed on the coast. Normally the Gault gives rise to thick swamps, but springs are often thrown out at different levels in the overlying Greensand. Traced from east to west the Gault oversteps progressively on to lower formations, from Oxford Clay in the east to the Bridport Sands in the west.

Upper Greensand.—This formation is of importance from the point of view of water resources. Messrs. Welch and Buchan have found that it consists of three recognizable parts. At the top a prominent band of hard calcareous grit underlies the Chalk, and covers a locally hard, glauconitic sandstone, with many *Exogyra* shells; beneath the grit and sandstone, bands of chert appear at Maiden Newton and increase in thickness westwards. At the base of the formation lie thick beds of sand called the Foxmould.

Pleistocene.—North of Beaminster upon the highest part of the Chalk ridge at 800 feet above O.D., a small area of pebbles forms an ' island ' within the spread of Clay-with-flints. The

¹ *Quart. Journ. Geol. Soc.*, vol. lxxviii, 1922, p. 381.

pebbles are small and rounded, and consist of quartz, quartzite, schorl and other rocks from the west of England, set in a sandy matrix. Small vertical pipes of grey clay penetrate the sand. Similar pebbles frequently occur at the top of the Clay-with-flints in the shallow gravel pits.

In the neighbourhood of the ridges of Cretaceous rocks, upon the sides of the hills and also in the lower ground, a thick wash is often present; it forms an 'angular chert drift.' It usually consists of angular to sub-angular chert fragments, and occasionally some flints, mixed with yellow plastic loam; at the base there is frequently a thin bed of angular chert.

INDOOR WORK

Work was continued on the preparation of dry proofs of twelve six-inch London maps by Mr. Buchan and Dr. Welch. This group is now being engraved at the Ordnance Survey Office. Another group is well advanced, and will shortly be despatched for engraving.

The Reigate map (Sheet 286) was printed off and the MS. of the memoir is practically ready for the printer.

The memoir on Torquay (Sheet 350) is in slip-proof, and should soon be published.

Members of the field staff delegated for Museum work made good progress with exhibits. Mr. Edmunds spent several months upon the preparation of a geological model of the Weald, and of a series of block diagrams illustrating the structure, variation in thickness and effect upon scenery of the Wealden deposits, and in arranging exhibition cases. Some of these exhibits were shown in November at the conversazione of the Geologists' Association at University College, London.

Mr. Dewey, with the co-operation of Dr. Welch, arranged four cases illustrating the geology of the South-western region, and in the autumn spent several weeks collecting specimens in North and South Devon and Cornwall.

Public Enquiries.—The demand for information with regard to water supplies from underground sources has increased during the current year, while questions relating to soils, foundations for buildings, dams and docks have also increased. Much time is taken up with these enquiries and with interviews, and during the year Messrs. Dewey, Dines and Edmunds dealt with over 400 such enquiries. In August Mr. Dewey lectured to the delegates of the International Congress of Prehistory and Protohistory at King's College, and led an excursion to the Swanscombe gravel pits where 120 delegates were present.

Soil Conferences.—Mr. Dines attended the tour of inspection carried out by the Soils Correlation Committee in Scotland during August. The soils in the Lothians, Ayr, the Trossachs, Perth and Aberdeen were inspected and classified, and the results

will shortly be published in a Report of the Committee. In June Mr. Dines visited the Pershore fruit-growing district with Dr. T. Wallace of the Long Ashton Fruit Research Station of Bristol University. A soil survey is there being made, and Mr. Dines explained the effect upon the soils of surface washes and local drifts. He has also described numerous soils submitted for examination by the Forest Products Research Laboratory.

Mr. Edmunds visited the excavations in the Fenland deposits at Wiggenhall St. German, Norfolk, where he noted four beds of peat separated by marine silts. Records of his work will be published in a paper by Dr. H. Godwin of Cambridge University, dealing with the pollen analysis of the peat beds. He also attended a field examination of the drifts near Saffron Walden.

Mr. Lloyd visited the works of the Paignton Drainage Scheme and collected geological information from shafts, tunnels and surface excavations. Specimens from four deep shafts and nearly two miles of tunnel have been examined. These operations provide a horizontal section four miles long, linked up by eleven shafts.

KENT COALFIELD

Mr. Dines has written a report on the Kent Coalfield which he visited in 1931. This work involved the correlation of the sections proved in numerous boreholes and in the shafts. He has been able to construct contour maps of certain seams of coal which are persistent throughout the field. The report is ready for publication.

H. DEWEY.

2. WEST MIDLANDS AND CAMBRIDGE DISTRICTS

C. H. DINHAM, B.A., District Geologist.

E. E. L. DIXON, B.Sc., A.R.C.Sc.

R. L. SHERLOCK, D.Sc., A.R.C.Sc.

R. W. POCKOCK, D.Sc.

T. H. WHITEHEAD, M.Sc., A.R.C.Sc.

T. N. GEORGE, D.Sc., Ph.D., Geologist.

} Senior Geologists.

FOR a large part of the year the members of this unit were engaged in preparing exhibits for the new Museum, and Mr. Dixon alone has enjoyed a full season of mapping in the field. The needs of the Museum have further involved postponement of much of the indoor map-work that must always precede publication.

The survey of the Dudley Sheet (167) has been completed, and the last six-inch maps of the Dudley Coalfield are passed for printing-off. The Shrewsbury map (Sheet 152) is issued, and the memoir is due for publication. The Saffron Walden memoir was published during the year, and the map (Sheet 205) has also been issued.

Numerous journals of wells and borings for water have been received, copied and filed. These records are of the greatest importance to the geologist, and their collection in large number is an essential task which, however, involves a complementary readiness to answer the enquiries of the general public, any member of which may possess such information. The time occupied in this kind of mutual assistance is increasing year by year.

Mr. Dinham has been much employed in editing English and Scottish memoirs. In addition he has assisted in preparing a new edition of the 'quarter-inch' map (solid) of southern East Anglia (Sheet 16); in this the Pliocene boundaries have been modified in accordance with the latest information, and advantage has been taken of the first opportunity that has occurred since the recognition of its Corallian age, some 40 years ago, to separate the Ampthill from the Oxford Clay over the whole of the area covered. A revised edition of the Atherstone map (Sheet 155), with additional bore-sites, has also been prepared.

Among other miscellaneous work carried out by the staff, Dr. Sherlock has helped to bring up to date the International Geological Map of Europe, so far as concerns England and Wales, while Dr. George has assisted in selecting specimens of Welsh slates for test by the Building Research Station.

WEST MIDLANDS DISTRICT

With the mapping of its southern edge, six-inch revision of the Dudley Sheet (167) was completed, and extended into the Droitwich map (Sheet 182), of which nearly one-third has now been

surveyed. Dr. Pocock was engaged in the area around Highley and Cleobury Mortimer, Mr. Whitehead in the north part of the Wyre Forest, and Dr. George in the country adjoining Droitwich on the south and south-east.

Silurian, Downtonian and Old Red Sandstone.—Part of the small Silurian inlier at Neen Sollars enters Sheet 182, and has been mapped by Dr. Pocock. The beds, which are poorly exposed, include Lower Ludlow Shales with a typical trilobite and brachiopod fauna, Aymestry Limestone to a thickness of about 60 ft., Upper Ludlow Shales with the usual *Chonetes* and *Rhynchonella*, and Temeside Beds; these last include a bone-bed detected in the railway-cutting. The sandstones of the lower part of the succeeding Downtonian, which are remarkably micaceous, are associated with red marls and succeeded by a bed of coarse grit. The marls and cornstones which crop out in the syncline at Cleobury Mortimer are apparently of Lower Old Red Sandstone age.

Coal Measures.—Among some plant-bearing shales in a railway-cutting near Eymore Farm, Trimpley, Mr. Whitehead found a thin greenish grey sandy mudstone with shells that have been identified by Dr. C. J. Stubblefield as *Lingula mytiloides* J. Sow. and *Buxtonia* sp. This marine bed seems to correspond in stratigraphical position to one noted by Dr. Pocock and Mr. Templeman in the 1929 boring near Kinlet, 3 miles to the north-west, about 150 ft. above the horizon of the Brooch Coal. These two occurrences are the first records of marine bands in the Forest of Wyre Coalfield.

A new bore has been examined by Dr. Pocock and Mr. Templeman at Ingram Lane, three-quarters of a mile west-south-west of Hampton Loade Station and about $2\frac{1}{2}$ miles north of the Kinlet bore. It started just beyond the outcrop of a *Spirorbis* limestone, and showed some 130 ft. of Keele Beds resting on the Halesowen Group, which is about 685 ft. thick and contains a coal, probably the Brockhall, at 498 ft. depth, a *Spirorbis* limestone at 557 ft., and a second coal at 643 ft. The lower coal is possibly the Main Sulphur Coal, and the limestone the bed mapped at Tasley and Deuxhill to the north.¹

A coal associated with *Spirorbis* limestone is also known in the country south of Highley and Kinlet Collieries, and was identified as the 'Main Sulphur Coal' by T. C. Cantrill,² who traced coal and limestone together from Buttonoak to Arley Station. Mr. Whitehead has discovered new occurrences of these seams, but regards the correlation as very doubtful, for in the northern area the Main Sulphur Coal and the limestone lie well up in the Halesowen Group, among the greenish buff sandstones of 'Halesowen' type, whereas in these southern occurrences they lie definitely below

¹ 'Summary of Progress for 1929,' Part i (*Mem. Geol. Surv.*), 1930, p. 50; and *ibid.*, for 1930, Part i, 1931, p. 40. See also T. C. Cantrill, *loc. infra cit.*

² 'A Contribution to the Geology of the Wyre Forest Coalfield,' *Kidderminster*, 1895, p. 20.

the lowest thick sandstone of that type. One of the new exposures of the *Spirorbis* limestone is in a brook, about 500 yds. south-south-west of Severn Lodge; a few feet lower is the position of a coal seam, formerly worked near here. Traces of both beds were found on Skeets Farm, near Arley Station, and followed to Woodhouse Farm near Buttonoak. The limestone also occurs in place in a brook at a point 150 yds. north-north-east of Winwoods, where it is again associated with a coal and overlain by a thick sandstone of 'Halesowen' type; there is little doubt that this is the Severn Lodge bed, but it is separated from the Buttonoak occurrence by an area of lower measures, brought up by the fault proved in Highley Colliery near Highley Station and now traced southward to Woodhouse Farm and into the Droitwich Sheet.

Trias, Rhaetic and Lias.—The undulating tract of Keuper Red Marls in which Droitwich is situated is overlooked from the east by the Rhaetic escarpment, separated into two portions by a fault which runs eastward through Shernal Green and Harman's Hill and has a considerable downthrow to the south. Dr. George finds that the Tea Green Marls constitute the higher slopes of the scarp face, while the Rhaetic beds, consisting¹ of a lower division with coarse micaceous fossiliferous sandstones and an upper one of black shales, usually crop out just below its summit; in several places the arenaceous division forms the dip-slope at the back of the scarp.

The lower beds of the Lower Lias, which occupy most of the remainder of the area mapped, but are nowhere clearly displayed, have been divided into three broad groups.² The lowest beds are grey flaggy limestones with interbedded shales, once much quarried near Saleway and Phepson in workings that are now overgrown. The other two divisions consist of shales with buff earthy limestones and ammonites of the Planorbis and Angulata Zones. These strata have been thrown into shallow folds. Thus a syncline, truncated by the fault, runs between Shernal Green and Goosehill Green, with Angulata beds along its axis; to the east of this the Rhaetic and Tea Green Marls are brought up in a faulted anticline between Himbleton and Shell; and still farther to the east, a short distance beyond the edge of Sheet 182, beds of the Angulata Zone are once more at the surface. A faulted anticline, east of Crowle (Sheet 199), brings Tea Green Marls and Red Marls to outcrop.

Glacial and Recent.—The terraces of the River Salwarpe are the most important Pleistocene deposits around Droitwich. The extensive flats upon which Witton and Copcut stand are relics of a platform about 80 to 90 ft. above the level of the recent alluvium; igneous erratics of North Welsh and Scottish types are common in the gravels. Droitwich Newtown stands on an intermediate

¹ Richardson, L., *Proc. Cotteswold Nat. Field Club*, vol. xv, 1904, p. 19.

² *Id.*, *Trans. Worcs. Nat. Field Club*, vol. iii, part 4, 1906, p. 188.

terrace, 50 ft. lower, which seems to continue the prominent terrace of Rashwood and Upton Warren surveyed last year. Salwarpe Court and church are probably built on yet another terrace, some 10 to 12 feet lower still. The gravels capping the prominent hills near St. Peter's Church and at Hadzor House are probably to be correlated with those on the ridge between Wychbold and Impney,¹ and so perhaps with the Main or Fluvio-glacial Terrace of the River Severn.

Fragments of *Rhinoceros antiquitatis* and *Elephas primigenius*, long ago identified by Dean Buckland, have been presented to the Survey by Mrs. Gurney of Shakenhurst (near Cleobury), where they occurred in gravels about 100 ft. above the present level of the River Rea.

CAMBRIDGE DISTRICT

The Saffron Walden map and memoir having been disposed of, progress has been made with the full revision of the Biggleswade district (Sheet 204) on the six-inch scale. Nearly two-thirds of the ground has been covered by Mr. Dixon working in the country around Royston, and by Dr. Sherlock in the latitude of Sandy and the tract between Gamlingay and Baldock.

Jurassic Clays.—A boundary is being drawn between the Oxford and the Corallian (Amphill) Clays, first distinguished in the adjacent Sheet on the north by C. B. Wedd in 1900. The Elsworth Rock, which there separates the clays, extends a short distance into the Biggleswade Sheet, but is absent, as an oolitic limestone, at Sandy. Here the Amphill Clay, first recorded by Professor A. Morley Davies,² is exposed in section between the Lower Greensand and the Oxford Clay (with fossils of the Rengeri Zone), and from the measurements of Mr. Dewar, together with reports on the fossils, its thickness is probably 16 ft., certainly not more than 22. No exposures are known between Sandy and Amphill, where the clay is believed to be about 60 ft. thick, but there is some probability that its outcrop is continuous throughout, and nowhere completely overlapped by the Greensand. In a well at Biggleswade black clay immediately underlies the thin outlying cake of Greensand, while the beds of Amphill Clay found at the waterworks, 2 miles south-south-east of Biggleswade Station, total as much as 67 ft., and, though found only as a glacial 'boulder,' suggest the presence of an outcrop a short distance away in a north-westerly direction.

Advantage was taken of an opportunity to study the Upper Jurassic clays, so rarely well exposed, in an excavation for an underground reservoir at Long Stanton All Saints, 11/16ths of a mile south-west by south of the church. Facilities for the examination by Messrs. Dewar and Dixon were kindly granted by

¹ 'Summary of Progress for 1931,' Part i (*Mem. Geol. Surv.*), 1932, p. 44.

² *Geol. Mag.*, 1916, p. 399.

the engineers, Messrs. G. W. Lack and Sons. The locality is in the Huntingdon Sheet (187) and from Mr. Wedd's mapping it appears to be on Amphill Clay, near the junction with the Kimmeridge Clay. Beneath 2 to 7 ft. of superficial gravel 19 ft. of clay were seen, the upper 6 ft. being pale grey-brown and soft, and the remainder rather dark bluish and stiff or compact. Ammonites from 1 to 12 in. in diameter were found throughout, some in excellent preservation, together with belemnites and lamellibranchs. Pending exact determination of the fossils it can be stated that the clays resemble the Amphill Clay of this region, and differ at least from the Oxford Clay in the frequency with which the numerous oysters, and sometimes other shells, are overgrown with *Serpula*.¹

Lower Greensand and Gault.—The phosphatic nodules formerly wrought at Potton and Sandy Heath are scattered abundantly over the fields, but are no longer to be seen there in section. At Sandy, in the recreation ground adjoining the railway, Dr. Sherlock and Dr. B. Smith observed a band of nodules with abundant fossils in a quarry-face of Lower Greensand. This interesting deposit is described by Dr. Kitchin on another page (p. 81).

A well and boring at Wicken (Sheet 188), sunk by Messrs. G. W. Lack and Sons, was visited by Mr. Dixon. The locality is of especial interest as being the northernmost in Britain to yield an extensive and general Gault fauna.

Chalk.—Between Shepreth and Guilden Morden Mr. Dixon finds that the maximum change in the Lower Chalk from mainly argillaceous to mainly calcareous beds occurs not at the Totternhoe Stone, lying on the so-called Chalk Marl, but some 40 ft. below it. This fact is of much importance to the makers of Portland Cement, who annually export many thousands of tons from the district. They find that the percentage of calcium carbonate above that line is so high that this 'Chalk Marl' can be burnt for ordinary lime. They are thus enabled to obtain high-carbonate marl for slurry from below the Totternhoe Stone, and do not need in this district to open up quarries on both sides of its outcrop in order to secure the correct proportions for high-class cement.

Pleistocene and Recent.—The drift deposits in Mr. Dixon's eastern area are of great interest and complexity, but their description must await completion of the field survey. In the west, boulder-clay has been found by Dr. Sherlock low down in the banks of the River Ouse about half a mile south of Great Barford Church, suggesting the possibility of the present river-bed at Great Barford being post-Glacial.

¹ Cf. Wedd, C. B., 'On the Corallian Rocks of St. Ives and Elsworth,' *Quart. Journ. Geol. Soc.*, vol. lvii, 1901, p. 83.

The River Ouse is bordered by a gravelly flat which, wider upstream, has contracted to about $1\frac{1}{2}$ miles at Willington. This gravel is in many places scarcely distinguished by any feature from the alluvium, although in others there is a low bank between the two. The upper boundary of the gravel flats is very indefinite; the gravel thins out imperceptibly as the clay beneath rises to the surface, and its last vestiges remain as gravelly pockets in the clay of Cople and Willington parishes.

Two patches of gravel, at Willowhill Farm west of Moggerhanger, and at Blunham, represent a high level gravel of the Ouse. Apparently the river at one time flowed farther south than at present, through Blunham village, tapping its tributary the Ivel about $1\frac{1}{2}$ miles higher up than at the present day.

The right bank of the River Ivel receives a small tributary from Potton at Biggleswade Common. Between Potton and Sutton the narrow alluvial flat of this stream widens into a lake-like expanse, the middle of which is peaty. Half a mile below Sutton the stream enters a considerable flat of alluvium, sand and gravel, forming a roughly rectangular expanse about $1\frac{1}{2}$ miles in each dimension. The inner part of the area is a peat bog. Appearances suggest ponding up of the stream into lakes, firstly between Potton and Sutton and later between Biggleswade and The Lodge, Sandy.

C. H. DINHAM.

3. YORKSHIRE DISTRICT

HEADQUARTERS : YORK

C. E. N. BROMEHEAD, B.A., District Geologist.	
D. A. WRAY, PH.D., M.Sc., Senior Geologist.	
J. V. STEPHENS, B.Sc., B.ENG.	} Geologists.
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WAKEFIELD AND BARNSELY SHEETS

DURING the year considerable progress has been made in the re-survey of the Wakefield and Barnsley Sheets (78 and 87) of the one-inch map: both Sheets are now nearing completion.

Lower Coal Measures.—Mr. Stephens has been surveying an area around Wharnccliffe, Grenoside, High Green, Hoyland and Elsecar in the south of the Barnsley Sheet.

Faulting and the coincidence of massive developments of both the Loxley Edge and Wharnccliffe rocks in the Lower Coal Measures at Wharnccliffe Chase had resulted in a confusion of their respective outcrops during the original survey. An attempt has been made, assisted by some recent mining information, to rectify this. This massive, coarse-grained phase is local and is confined to an area between Deepcar and Oughtibridge.

South-eastwards from Wortley the country-relief decreases so that the Penistone Flag Series and the measures to the Silkstone Rock form a broad stretch of undulating country crossed by a number of dip faults.

A deep boring in Huddersfield, which was carried through almost the whole of the Lower Coal Measures, was kept under close observation by Dr. Wray. It revealed a number of bands with non-marine lamellibranchs, together with a marine band in the higher part of the measures, the presence of which had been hitherto unsuspected.

Middle Coal Measures.—In the Wakefield district measures below the Barnsley Coal have been mapped by Dr. Wray. Of the coals mined, the Haigh Moor and the Middleton Main (Silkstone of West Yorkshire) are the most important. The Haigh Moor Coal is separated by a varying thickness of shale from a thinner seam usually called the Low Haigh Moor. To the west of Wakefield this shale is over thirty feet in thickness and both seams are mined, but north and east of Wakefield the Low Haigh Moor is worthless. Throughout this district the Haigh Moor is a valuable bed of coal, and has been extensively mined for both industrial and domestic requirements.

Mr. Bromehead has worked on the corresponding measures between Silkstone and Barnsley. The Silkstone, Parkgate and Flockton coals are being mined, and opportunity was taken to collect typical samples of the Silkstone 'branch' and Flockton 'brasses' to illustrate the meaning of these local terms. The Fenton Coal also is worked near Stainborough, and the outcrop, not shown on the original survey, was traced for a considerable distance. North of a west-and-east line through Woolley and Ryhill the Barnsley Coal passes into the Warren House facies with many dirt partings.¹ Around Barnsley the seam has been so constantly worked from surface that the outcrop can be laid down accurately for many miles. South-west of Worsborough Reservoir the outcrops are not shown on the published six-inch Sheet, but pencil notes on the field-slips show that it was recognized, and the depths to it at a number of shallow shafts are given. In the immediate neighbourhood of Barnsley also the value of Green's original work has been lessened by the method of publication. On the map the crops of the Kent's Thick, Winter and Two-foot coals are shown with unbroken lines; yet they pay little attention to the shape of the ground and have long been known to be far from accurate at many points. Reference to the original field-slips shows that these crops were calculated from the section of a shaft at a considerable distance from the crops of the Barnsley and Kent's Thin coals as actually traced on the ground.

Of the seams between the Barnsley Bed and the Woolley Edge Rock the Winter is a valuable house coal which has been mined for many years to the east of Wakefield, but around Barnsley the Two-Foot is now more worked. Careful collecting by Mr. W. R. Barker showed that a marine band occurs a few feet above the Two-Foot Coal;² with his assistance this band has been found at a number of localities. We are further indebted to him for much useful information as to the crops of the various seams within the town of Barnsley, information resulting from careful observation of temporary sections for many years.

Dr. Mitchell has mapped the country between Rawmarsh and Hemsworth. On the south-east the area is bounded by the group of faults forming the North Don fault-belt which throws down the measures some 90 yards to the south-east. These faults form an approximate boundary between the rocks dipping steeply to the south-east along the line of the River Don and those inclined gently to the north-east in the country between Rawmarsh and Wath-upon-Dearne. In the latter area the measures dip steadily with few faults.

Coals are not well exposed, but an excellent section of the Kent's Thick Coal is afforded by the brick pit, 800 yards south of Upper Haugh Church. A *Carbonicola* band is situated about 35 ft. below the Kent's Thick Coal resting on a thin coal. The Abdy

¹ Wray, D. A., 'The Barnsley Coal and its Variations,' 'Summary of Progress for 1926' *Mem. Geol. Surv.*, 1927, pp. 127-137.

² *Proc. Yorks. Geol. Soc.*, vol. xxi, part iv, 1931, pp. 329-333.

Coal was recently exposed in a new road-cutting at Rose Hill, Rawmarsh. In the northern part of the cutting it is 'washed out' by the overlying Abdy Rock. No such rock, between the Abdy or Winter Coal and the Two-Foot, is found near Barnsley, but farther south Mr. Stephens finds that, between High Green and Wombwell, a rock puts in whose behaviour is comparable with that of the succeeding Woolley Edge Rock and Oaks Rock. The Abdy Rock is strongly represented at Hoover, but dies out on reaching the Elsecar valley to the north-west, while the Woolley Edge Rock is more prominent to the north-west at Blacker Hill and rapidly dies out to the south-east on crossing the same valley.

The Woolley Edge Rock and Oaks Rock have been mapped by Dr. Wray and Mr. Bromehead south and south-east of Wakefield and near Barnsley, including the areas from which these rocks respectively are named. The determination of the exact positions of these rocks at the type localities will necessitate some revision of the use of these names in the Concealed Coalfield. Mr. Edwards finds that the Oaks Rock is not present east of a line joining Altofts and Ackworth Moor Top.

The measures above the Oaks Rock consist of a thick series of shales with several unimportant coals and impersistent beds of sandstone. The occurrence of two marine bands in the higher part of the Middle Coal Measures recorded in last year's *Summary of Progress* (Part i, p. 48), has also enabled us to make a correlation of the higher measures with greater precision and confidence than was possible during the former survey of this area. Around Glass Houghton Mr. Edwards finds that the Mansfield Marine Band lies about 30 ft. above a coal known as the Wheatworth, which here reaches its maximum thickness of 3 to 4 ft. and has been worked; elsewhere this seam appears to be worthless. Dr. Mitchell has mapped the crop of the Mansfield Marine Band near Manvers Main Colliery, the most southerly exposure yet recorded. His attention was drawn to its presence in the colliery brick pit by Mr. C. P. Finn.

Measures above the Mansfield Marine Band have been mapped by Mr. Edwards in the area between Castleford, Pontefract and Ackworth. Coal seams are relatively unimportant and only the Shafton has been extensively exploited. A more notable feature is the presence of several thick beds of soft and rather coarse sandstone—the (Glass) Houghton Rock, the local sandstones below the Shafton horizon at Ackworth, and the Ackworth and Pontefract rocks.

The Shafton Coal has been worked from Hemsworth Colliery and at the outcrop in Nostell Park, but has not been positively identified around Ackworth and in the Pontefract Trough. It is likely that it does not continue far north of the Woolley-Askern line as a workable seam.



Dark shales with *Pterinopecten* are exposed in a cutting between Pontefract and Carleton¹ and represent the Shafton or Top Marine Band.

The Ackworth Rock is about 80 ft. thick at Ackworth Moor Top, where there is a large output of high quality grindstones from numerous quarries. Its base lies about 250 ft. above the Shafton Coal at Hemsworth. At Pontefract the Pontefract Rock is underlain by a thick sandstone which Green considered might be Ackworth Rock;² we are now in a position to confirm this correlation.

New evidence underground and on the surface has allowed the trough-faulting at Pontefract to be mapped more accurately and its north-eastward extension to be followed some distance beyond Ferrybridge, where it affects Permian and Triassic rocks. Several faults have been found in the obscure country around Ackworth and have been traced, in some cases, by auger-boring.

Apart from routine field work Dr. Wray examined the cores from a new boring at Mansfield Colliery in Nottinghamshire. In order to interpret the succession it was found necessary to examine specimens retained during the sinking of shafts at several neighbouring collieries. These showed that the marine band which occurs about 350 feet above the Deep Hard Coal in Nottinghamshire³ has a wide extent and will therefore doubtless prove a valuable index horizon during the future investigation of the measures below the Top Hard Coal in this area.

Permian and Triassic Rocks.—Mr. Edwards has mapped the Permian outcrop and most of the country to the east as far south as Pontefract.

The Basal Sands form a discontinuous outcrop and are mined near Pontefract for moulding-sand, mainly for iron-castings. The Lower Limestones contain reef-knolls near Pontefract. The Middle and Upper Marls have both been exploited for gypsum, the recent workings at Hillam being extensive. Great areas of the Upper Limestone have been removed at Knottingley and Brotherton, mainly for lime-burning, but the industry has now almost vanished.

The Bunter Sandstone in the low country east of the Permian outcrop is plastered with a sheet of silts, sands and laminated clays, through which it projects here and there, notably at Hambleton Hough and Kellington.

Near Upton Dr. Mitchell was able to recognize the Basal Permian Sands at the base of the Lower Magnesian Limestone, which forms Upton Beacon. The main outcrop of the Limestone is faulted for a considerable distance from Minsthorpe north-eastwards through North Elmsall. The unfaulted base, however, may

¹ 'The Geology of the Yorkshire Coalfield' (*Mem. Geol. Surv.*), 1878, p. 471.

² *Ibid.*, p. 470.

³ Wilson, G. V., 'The Concealed Coalfield of Yorkshire and Nottinghamshire' (*Mem. Geol. Surv.*), 2nd Edition, 1926, p. 17.

be traced leaving the fault east of Upton Beacon and extending north-eastward almost to the Great North Road.

At Upton Beacon sandy dolomite in places overlies the Basal Sands and, above this, oolites, pisolites and compact limestones occur. Thick beds of pebbly oolite and several small reef masses are found in the railway-cuttings near Wrangbrook.

Glacial Deposits.—Mr. Edwards considers that the sands, silts and laminated clays overlying the Bunter Sandstone may be contemporaneous with the first and possibly also with the second terraces of the lower Aire and Calder valleys. The projecting hills of sandstone are capped by much older gravels.

Boulder-clay with many far-travelled stones, including erratics from the Lake District, covers a large area to the south of Royston. Farther north many patches of highly weathered boulder-clay lie on the hilltops over the country east of Leeds and Wakefield and appear to be fragments of a once continuous sheet. At Woolley and Notton gravels of doubtful origin occur at varying levels; in these the material appears to be almost entirely of local origin. The alluvium of the Calder, however, appears everywhere to rest on a coarse gravel in which far-travelled stones, including Lake District erratics, are comparatively common. The gravel is at present being extensively worked at Horbury and Stanley.

General.—Early in August the office was removed to more commodious quarters at 32, St. Mary's. The usual enquiries as to water supply have been dealt with, notably in connexion with the proposal to supply Hull from a catchment reservoir west of Scarborough. On behalf of the Wakefield Corporation Waterworks Dr. Wray prepared a report on the possibilities of supplementary supplies from borings in the catchment areas on Rishworth Moors.

During the visit of the British Association to York the staff placed themselves at the disposal of the geological section, and their efforts in conducting excursions and in other ways were much appreciated.

C. E. N. BROMEHEAD.

4. LANCASHIRE DISTRICT

Headquarters : Manchester

W. B. WRIGHT, Sc.D., M.I.M.E. District Geologist.

L. H. TONKS, M.Sc.

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} Geologists.

SIX-INCH Sheets have now been prepared covering the greater part of the area embraced in Sheet 84 (Wigan) and the remainder will be completed early in the coming year. A small amount of field work has also been done in Sheet 98 to the south of Manchester and in Sheet 75 (Preston), the former with the object of providing the Manchester Civic Survey with a complete and up-to-date geological map of this district.

WIGAN AND ST. HELENS SHEET

Coal Measures.—Dr. Wright has been engaged on the completion of the work started by Dr. Sherlock in the St. Helens area. Here a reasonably good local correlation of individual seams has been arrived at, but the higher mines, corresponding generally to the Ince Group of Wigan, still present some difficulties. The wider correlation with Wigan and the east has up to the present only been satisfactorily established in respect of certain of the main seams or groups of seams.

A feature of the St. Helens area which presents great difficulties of interpretation is the upward passage of the Middle Coal Measures into variegated marls. This passage appears to take place without unconformity at stratigraphical horizons varying from place to place, and plants of Carboniferous type have been obtained from the marls. The latter cannot therefore be regarded as a basal phase of the Permian or Triassic. It also seems impossible to refer them to the Ardwick Group, since they succeed the Coal Measures at horizons over a thousand feet below the base of this group.

Mr. Tonks continued the preparation of six-inch maps in the western part of the Wigan district during the early part of the year.

Mr. Jones has been employed throughout the year on the completion of the six-inch coalfield maps of Sheet 84 (Wigan). The ground is everywhere heavily faulted and the geology complex. Up to the present the correlation of the coal seams has not presented great difficulty except in the case of the Ince Mines.

The examination of colliery tunnel sections and mine plans is now largely completed. We are indebted to the officials of the colliery companies, particularly the surveying staffs, and to the

mining engineers, for their assistance and for the trouble to which they have gone to elucidate the more complex areas of the coal-field. Without their willing assistance it would not have been possible to arrive at a solution of the geology of considerable areas in which faults and outcrops can now be shown with a good deal of accuracy.

Glacial and Recent.—The dominant surface formation to the north of St. Helens is the Shirdley Hill Sand, the exploitation of which for glass-making involves its removal to a depth of three or four feet over large areas. This process is carried out with such care as to leave the land unimpaired for agricultural purposes, the soil being stripped off and replaced at the lower level. The sand covering is generally thinner on the higher ground, but there are few areas where it is so completely absent as not to produce a sensible modification of the character of the soil.

SOUTH MANCHESTER AND STOCKPORT AREA

Early in June Mr. Tonks commenced work in the South Manchester area in Sheet 98 to complete a set of maps required for the Manchester Civic Survey. The re-survey was greatly facilitated by the number of borings that have been made. Ready access to records was again given by Messrs. E. Timmins, Messrs. T. Matthews, Messrs. J. Thom and Messrs. Wm. Matthews, and the well-kept records of the City Engineer's office at Manchester provided a fund of information. The structure of the ground necessitated the revision of part of Stockport lying to the east of the required six-inch maps, and here Professor Kendall, who has accumulated records over a period of forty years and has a personal acquaintance with sections long since built over, rendered invaluable aid. The revision of the Stockport map serves an additional useful purpose in view of the number of enquiries received in respect of water borings in the town.

Structurally, the area shows the swing from the northerly strike of the beds on the western limb of the Pennine anticline at Stockport, to the east-west strike of the northern rim of the Cheshire basin, which is manifest farther west. The main faults run north-westwards as they do in the area to the north, and two of the master faults of Manchester, the Pendleton Fault and the Irwell Valley Fault (joined by the Bradford Fault) continue south-eastwards across the Mersey.

Carboniferous.—The marls and limestones of the Ardwick Group were proved many years ago in the railway-cutting at Levenshulme. The continuation of this outcrop to the south is obscured by drift and has not been proved in any borings that have so far been made. Shales with Coal Measures plants, separated by angular unconformity from the overlying Collyhurst Sandstone, have been seen in borings in Stockport at the Unicorn

Brewery and Portwood Gas Works visited some little time ago by Dr. Wright. The red colouration of these shales was demonstrably due to staining by the superincumbent Permo-Trias, and other considerations lead to the conclusion that they lie at a lower horizon than that of the Ardwick Group.

Permo-Triassic.— At Stockport the outcrops of the Collyhurst Sandstone, Manchester Marls and the lower part of the Bunter Sandstone are repeated by faulting and run in narrow north-westerly bands across the town. West of this, however, the Bunter Sandstone occupies the ground as far west as Northenden, except for a small patch of Manchester Marl brought up by the Pendleton Fault at Heaton Mersey. About Baguley, Sale and Northenden boring records show marl with sandstone bands beneath the drift, and this area has been mapped as Keuper Waterstones. In the districts lying to west and south of the present area a thick band of strong sandstone, the Lower Keuper Sandstone, has been recognized and mapped between the Keuper Waterstones and the Bunter. No evidence bearing on the question of the presence or absence of this sandstone has been obtained in South Manchester, however, and an arbitrary line has been drawn between the marls with sandstones of Baguley and the Bunter Sandstone of the area to the north and east.

Glacial and Recent.—The glacial sands and gravels through which the Mersey has cut its steep-sided valley at Stockport are for the most part horizontally bedded, fine-grained sands, often overlain by a bed of coarse gravel. Their gently undulating top maintains a level of between 230 ft. and 240 ft. on both sides of the river. These sands are overlain by a thin bed of clay with few stones, seen east of Heaton Norris and at Edgeley.

West of Stockport the Mersey opens out into a wide valley floored by boulder-clay on which the sands and gravels of the river terraces rest. The High Terrace is composed in its upper reaches of extremely coarse gravel, stones up to 9 in. in length being fairly common at Cheadle. Westwards it becomes progressively finer in pebble and grain size until around Baguley it is mainly coarse sand with few pebbles. In this western area, about Baguley, Sale and Wythenshawe, a thin and irregular cover of blown sand, which is locally gathered in slight elevations above the general terrace, overlies the water-borne sands of the terrace proper.

The character of this area on the south side of Manchester is rapidly changing, and its agricultural character is disappearing before the advance of the city southwards. The sandy loam and loamy soils developed on the High Terrace flat provide valuable arable land upon which at Baguley, Sale and Northenden a flourishing market-gardening and farming community has been established for many years.

PRESTON SHEET

In the autumn Mr. Tonks spent a short period in the north-eastern part of one-inch Sheet 75 (Preston) where six-inch maps adjoining the Rossendale area have been completed and can be prepared for publication next year.

The structure hereabouts is dominated by the Clitheroe anticlinal axis. This has been traced west-south-west from Mellor Beacon, running south of Mellor Brook and Samlesbury Higher Hall to Hole Brook, one mile west by north of Nab's Head Inn.

The north-western side of the anticline is not well exposed. On the south-eastern flank the beds dip steeply and continue to display in the main the characters described in the memoir on the Rossendale area to the east (Sheet 76), but certain points are perhaps worthy of mention at this stage.

Millstone Grit Series.—In the Bowland Shales, in a small stream 500 yards north of Ramsgreave Hall, hard calcareous shales with earthy limestone bands have been found to contain *Posidonomya membranacea* and a goniatite comparable with *Cravenoceras malhamense*. The section above and below this isolated exposure is obscured by drift.

Under the basal grit, that is the Lower Wilpshire Grit, sandy shales with thin flagstone bands are seen in a stream 500 yards south-south-east of the Inn at Mellor Brook. Two of the thin arenaceous bands display remarkable grading from coarse to fine sand upwards. Although only two or three inches thick, the bands show a gradual change from the coarse and gritty character of the base to fine-grained sand in the upper portion. This grading from coarseness to fineness upwards has been found to hold good for the main beds of massive grit, especially in the case of the Wilpshire Grit, Parsonage Sandstone and Kinderscout Grit.

This last bed, which had been observed to thin westwards to 15 ft. in the area farther east, suffers further attenuation and is apparently represented by 2 in. of fine-grained silty sandstone underlying shales with *Reticuloceras reticulatum* in the stream east of Billinge Scar.

The Third, or Revidge Grit makes a fine ridge across country from Billinge Hill by Hoghton Towers to Windmill Hill. This bed is quarried for building stone, sand and concrete aggregate, and at Butler Delf provides a building stone which has more than a local reputation. In front of the dominant Third Grit ridge the Haslingden Flags make subordinate features in the drift-covered ground. They have not been quarried hereabouts to any great extent, although apparently of good quality.

In the synclinal area to the south the relations of the beds are by no means clear. The Rough Rock is present as a bed of coarse grit and is easily distinguished from the Woodhead Hill Rock above, which is well exposed at Feniscowles. In the gorge

of the Darwen at Feniscowles Hall the latter rock is seen to be in the lower part a coarse and gritty sandstone, which becomes finer upwards and finally passes into sandy shale and mudstone on which the Bassy Mine rests.

Coal Measures.—To the east of the Darwen Gorge shales rich in *Carbonicola* over the Bassy Mine are seen on the south bank of the Darwen. These underlie the outcrop of a second seam, which is probably the Lower Mountain Mine and which was worked in shallow pits many years ago.

Glacial.—In the valley of the Darwen about Feniscowles and Witton glacial sands lie on and under boulder-clay. These sands and gravels are extensively dug for building and concrete sand. They locally contain beds of soft loamy silt known as 'bing,' which is much prized as a moulding sand for the casting of brass and aluminium ware.

W. B. WRIGHT.

5. CUMBRIAN DISTRICT

T. EASTWOOD, A.R.C.Sc., District Geologist.

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THE re-survey of Sheet 23 (Cockermouth) was completed during the earlier part of the summer but much remains to be done before the results can be published. Later in the year the re-survey of Sheet 37 (Gosforth) was commenced, and field work on it was completed by the beginning of December.

COCKERMOUTH SHEET

Skiddaw Slates.—Although absolute proof of the true sequence of rock types in the Skiddaw Slates is still wanting, the evidence points to an arenaceous phase (Skiddaw Grit and its correlatives) in the lower part, passing upwards through grey sandy slates and striped siltstones (Mosser Slate type), and dark shales with occasional banding, to blue and black shales (Kirkstile Slate type) towards the top. If this version of the sequence be accepted, the thickness of the Skiddaw Slates is much less than hitherto supposed. Moreover, as Dr. Trotter points out, this lithological sequence appears to agree, in general, with the graptolite faunas, as determined by Dr. G. L. Elles from material collected in 1931 by Mr. S. W. Hester, on the western slopes of Skiddaw.

Dr. Trotter reports that similar rock types to those found in 1931 north of Dash¹ have been traced on the northern and western slopes of Skiddaw, and as far west as Bewaldeth.

In close proximity to the basic intrusions of Barkbeth and Ullock Pike, some of the dark bluish-grey slates have been altered to hard light grey slates with pin-head spotting, which closely resemble the mudstones of Blake Fell.

Some modification has been made of the line marking the outer limit of the Skiddaw metamorphic aureole at the coomb by Gibraltar Crags, a mile and a half south-east of Barkbeth. On the old map this line is drawn horizontally around the coomb, whereas it has now been found to plunge to the north-north-west at 1 in 1 and to form a V-shaped outcrop.

Farther to the east, Dr. Hollingworth has been able to map distinctive types of hornfels amongst the metamorphosed Skiddaw Slates and these will probably assist in elucidation of the structure of the area.

¹ 'Summary of Progress for 1931,' Part i (*Mem. Geol. Surv.*), 1932, p. 52.

At the foot of the fells near Wythop and at Peel Wyke, on the southern side of the wide Embleton valley, Mr. Rose notes that dark, striped shales and blue-black slates appear to be succeeded upwards by the striped flaggy shales and thin grits which give rise to the high ground about Ling Fell, Sale Fell and Wythop Fell. In spite of the prevalent southerly dip there is evidence to suggest that the rocks are overturned and that the flags and grits of the higher ground are in reality older and lower down in the sequence than the shales. Dark striped shales also crop out immediately south of the summit of Sale Fell, and though apparently again underlying the arenaceous beds they can be shown to be newer. These occurrences lead us to believe that there is a sharply pinched-in anticlinal fold, with an axis trending W.S.W.—E.N.E. along the steep southern slope of the Embleton valley. This general structure is complicated by several minor faults, small scale tightly packed folds, and strong but impermanent belts of almost vertical cleavage.

Minor Intrusions.—In addition to numerous intrusions similar in type to the rock quarried so extensively at Embleton there is the well-known minette of Sale Fell. This occurs as two sills, 20 to 30 ft. thick, amidst shales and flags at the summit of the fell. The rock is pinkish in colour and contains prominent flakes of dark greenish biotite in a feldspathic groundmass. This minette is useful as an indicator boulder in the Glacial drifts farther west.

Borrowdale Volcanic Group.—The faulted inlier of Borrowdale rocks in Greystoke Park at the eastern margin of Sheet 23 has yielded to Dr. Hollingworth a sequence of distinctive lavas comparable with those of the isolated outcrop about Berrier and Eycott Hill, but at Greystoke there is a greater development of rhyolites and the rocks have been cut by numerous basic dykes.

GOSFORTH SHEET

The area covered by this Sheet lies south of Whitehaven (Sheet 28) and includes the concealed iron-ore field of the Egremont district. The solid formations range from the Skiddaw Slates¹ to the New Red Sandstone, but are, for the most part, heavily drift-covered, especially towards the coast.

Mr. Eastwood re-mapped the coastal tract as far south as Drigg. Dr. Trotter was centred on Gosforth; in addition to field work, to him was allotted the task of collecting mining information and the records of borings, and he will be responsible for the elucidation of the structure of the concealed iron-ore field and its possible extensions. From the experience already gained in the Whitehaven district it was natural that Dr. Hollingworth should continue his mapping of the Ennerdale Granophyre and associated rocks in a

¹ The outcrop of the Skiddaw Slates was mapped during the re-survey of the Whitehaven district.

southerly direction; he therefore took over the re-survey of the eastern part of the Sheet as far south as the region of the valley of the Irt, while the southern part of the map, with part of the Eskdale Granite, was allocated to Mr. Rose.

Borrowdale Volcanic Group.—The outcrop of this group lies between that of the New Red Sandstone and the igneous masses of the Ennerdale Granophyre and the Eskdale Granite; but, since the former is unconformable and the latter intrusive, the structure of the Borrowdale Group bears no relationship to the shape of its outcrop.

Dr. Hollingworth states that, apart from the basal tuffs on the border of Sheet 28, there is an almost complete absence of mappable tuffs as far as the northern margin of the Eskdale Granite near Irton Hall.

A thick series of andesitic lavas—compact, fine-grained and porphyritic, pyroxene-rich types—crop out about Thornholme, and the lower part of Worm Gill. Epidotization is widespread in these rocks, especially towards the Ennerdale Granophyre, and they show metamorphism near that mass. They are followed to the south by a broad belt of flow-banded and flow-brecciated rhyolitic rocks that appear from beneath the Trias in the Calder half a mile south of Thornholme, and are traceable eastwards by Farmery and across the Bleng valley south of Scalderskew beyond the margin of Sheet 37.

To the south of this rhyolitic belt another set of acid lavas comes in. This includes a thick series of rather flinty acid types showing much autobrecciation, and some distinctive highly porphyritic varieties. These rocks exhibit marked colour changes, from dark greenish and bluish greys to reddish and pale grey tints, the latter being associated with the highly silicified flinty appearance and much disseminated pyrites.

Just before the Eskdale Granite is reached andesitic types recur and may be seen along the Irt, below Santon Bridge. The strike of the Borrowdale rocks in this northern region is north of east.

Between the Irt and the Mite the solid geology is obscured by Glacial deposits, but at the latter river Borrowdale rocks, comprising lavas and tuffs, flank the western margin of the Eskdale Granite.

Mr. Rose states that the lavas seen half a mile north-east of Ravenglass are dark green, compact, and often rather flinty andesites with small phenocrysts in parts. Similar lavas, but more frequently porphyritic, occur in contact with the granite near Newtown Knott, where they have suffered considerable alteration.

The tuffs are uniformly fine-grained and are frequently stained deep purple. They are to be seen a quarter of a mile west of Brankenwall, and in Muncaster Park. Hereabouts they are altered by the granite to tourmaline and cordierite hornfelses.

The strike of the Borrowdale rocks in this southern region ranges from south-south-west to south, and the dip is usually to the west at high angles, but the general succession is difficult to make out.

Ennerdale Granophyre.—According to Dr. Hollingworth the area of that portion of the intrusion which is included in Sheet 37 is considerably less than is shown on the old maps. He states that fine-grained and porphyritic, more or less marginal types, with some partially digested inclusions of a grey basic granophyre, prevail along Caw Gill and Caw Fell Beck, whereas on the higher ground between these streams and the Bleng valley there is a considerable development of basic granophyre which appears to be entirely enclosed in, and veined by, a more acid rock.

A number of felsite dykes, believed to be related to the granophyre, have been mapped in the tract of rhyolitic Borrowdale rocks, between the Bleng and Wasdale valleys.

Eskdale Granite.—Part of the western margin of this large intrusion is included in Sheet 37 and forms a narrow strip from the River Irt to the southern edge of the map at Corney.

Mr. Rose states that the granite is well exposed in the crags on Muncaster Fell, between Muncaster Castle and Newtown Knott, and near Waberthwaite; farther south it is largely obscured by boulder-clay and gravel. Several types occur. One, which we may speak of as the normal type, crops out at intervals from Muncaster Fell to south-west of Muncaster Castle, and is usually a coarse red granite, though it may be pink or light grey; this type contains muscovite but rarely biotite. Farther south, over a large area embracing Newtown Knott, Waberthwaite and Corney, there is a dark grey, occasionally red, basified granite rich in biotite. The presence in the rock of many dark, granular xenoliths and rounded biotite-rich patches suggests extensive assimilation by an acid magma of rocks of the Borrowdale Group.

These two types are quite distinct and are probably separated by a fault trending approximately west-north-west through Rougholme and Muncaster Park.

Associated with the red granite there is a more acid marginal variety which may be fine-grained or porphyritic. This may be seen along the contact near Brankenwall, and, passing into 'normal' granite, on the crags at the western end of Muncaster Fell.

Contacts between both normal and basified types of granite and hornfelsed rocks of the Borrowdale Group are to be seen at several places near Newtown Knott and Muncaster Park; in all cases the junction is fairly sharp and is inclined to the west at angles not less than 60° .

In the southern part of the area, on the east side of the main road between Lane End and Swallowhurst Hall, a belt of intense shear, up to 200 yds. in width and trending north-east, appears

to mark the junction between the basified granite and an obscure outcrop of the Borrowdale Group. Both rocks contribute to the shear-belt and show equally the effect of crushing, and a local approach to mylonitization. Some Borrowdale material is incorporated in the granite and appears as intensely sheared streaks and bands. The dip of the shear-banding is generally to the west at a steep angle.

A small area of the granite has been surveyed by Dr. Hollingworth to the south-west of Irton Hall. It consists mainly of reddish and grey, moderately coarse, muscovite-biotite-granite, with occasional ill-defined patches of finer grained material. Nests of tourmaline have been noted at one or two localities.

New Red Sandstone.—Dr. Hollingworth reports that the brockram at the base of the New Red Sandstone is fairly well exposed in the Calder valley above High Priorscale, where the outcrop is repeated by faulting, and again in the small stream to the east of that farmstead, where the fragments reach six inches in length and include much Carboniferous limestone in addition to material from the Lower Palaeozoic rocks.

Beds of fine brockram interbedded with sandstone and shale cropping out in a stream near Farmery indicate the nature of the junction between the brockram and St. Bees Sandstone.

The St. Bees Sandstone exceeds 3,200 ft. in thickness in the area covered by Sheet 37 for it was not bottomed at this amount in a boring at Seascale. Although it is believed to occupy a large tract of country, exposures are somewhat scanty, but Dr. Trotter records an almost continuous section in the River Calder between Calder Abbey and Calder Hall. It is noteworthy that rocks identical in appearance with Penrith Sandstone and Kirklington Sandstone are to be seen interbedded with typical St. Bees Sandstone¹ in the river at, and to the south-west of, Calder Bridge. Similar admixtures of types were noticed by Mr. Eastwood near Seascale.

Superficial Deposits.—The Glacial deposits which mask so much of the solid geology of the Gosforth district form an interesting link between those of Whitehaven² and those recently described by Dr. Smith³ which lie partly in our area. Considerations of space do not permit of lengthy descriptions or arguments but the results of the re-survey are mainly in accord with work in adjacent areas. It must suffice at this stage to state that there have been at least two glaciations of the district. The more important is that known as the Main Glaciation; this gave rise to the so-called Lower Boulder Clay and Middle Sands. Then, after a milder interval, came the ice of the Scottish readvance which is

¹ See also Bernard Smith, 'On the West Cumberland Brockram and its Associated Rocks,' *Geol. Mag.*, 1924, p. 307.

² See 'Geology of the Whitehaven and Workington District' (*Mem. Geol. Surv.*), 1931.

³ 'The Glacier Lakes of Eskdale, Miterdale and Wasdale, Cumberland; and the Retreat of the Ice during the Main Glaciation,' *Quart. Journ. Geol. Soc.*, vol. lxxxviii, 1932, pp. 57-83.

responsible for the Upper Boulder Clay and Upper Sands; these are confined to the coastal belt. Various glacier-lakes and drainage channels were associated with both glaciations. It may be noted in passing, however, that large areas of loamy soils hitherto mapped as sands are now relegated to boulder-clay.

The more recent superficial deposits include a patch of submerged forest off Drigg, raised warps and beaches between Seascale and Eskmeals, and modern alluvium—both freshwater and marine—in addition to blown sands.

T. EASTWOOD.

6. NORTHUMBERLAND AND DURHAM DISTRICT

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DURING the field season of 1932 Mr. Burnett, having completed the outstanding Coal Measure areas of one-inch Sheet 15 (Tyne-mouth) began field work on the Carboniferous Limestone areas round Kirkwhelpington, in the north-west corner of one-inch Sheet 14 (Morpeth). Mr. Eyles was precluded from taking part in this work, as he had been transferred, temporarily, to the London Office for Museum duties. Revision of Lower Carboniferous strata in one-inch Sheet 8 (Elsdon) was continued, Mr. Anderson taking the Upper Redesdale country as before, while Mr. Fowler was occupied in the higher reaches of the North Tyne, round Falstone : earlier in the year he had done much indoor work connected with the forthcoming Rothbury Memoir (one-inch Sheets 9 and 10).

Exploratory work in the coalfields was of no great account during the year, but an important boring for water was put down north of Morpeth. This gave 14-in. cores, and starting towards the base of the Millstone Grit soon got into Upper Limestone strata. The sandstones there proved useless, but a recommendation that the bore be continued to the Thornbrough (Stanton) Limestone was acted on, and proved entirely successful. Experience shows that in Northumberland the chief water-bearers are such limestone bands as are 10 ft. or more in thickness; the water comes from open joints or fissures in the stone, and in more quantity than from sandstones or grits.

Cementstone Group.—Clough's lower division of these rocks, the Lower Freestones, is found at Cottonshope Head, near the Border. About 80 ft. of coarse, false-bedded sandstone are seen, the upper 10 ft. hard and slightly calcareous. Lower down the valley are the Cottonshope Lavas, in three beds, each about 20 ft. thick. They thin away in all directions, the top bed being particularly limited. These flows have a petrological resemblance to, and may represent, the 'Kelso Traps' seen north of the Cheviots. A discovery of special interest is that about three-quarters of a mile west of Cottonshope Head a yellowish magnesian limestone lies a few feet above the lavas, and that it is very like the unbrecciated parts of the Carham Limestone, covering

the ' Kelso Traps ' in the Tweed valley. The remaining strata, up to the Fell Sandstone, cannot be more than 400 ft. thick : none of the cementstone bands therein is more than a few inches thick. South of the Rede a 50-ft. bed of cementstone conglomerate at the top of the Group is restricted to country north and north-east of Ellis Crag.

Scremerston Coal Group.—Work is not yet sufficiently advanced for any estimate to be made of the general sequence in these strata. In the North Tyne valley conditions are particularly difficult. There are some good sections, but they are isolated ; there is obviously much faulting, and index horizons are infrequent. Matters are better in Upper Redesdale, where typical Scremerston measures have been noted half a mile north-west of Blakemans Law (Street Head) in a tract formerly mapped as Cementstones. Trials in a 2-ft. coal have been made near Birdhopecraig Hall, and a 29-in. seam with 10-in. ' band ' has been got south of Black Blakehope. A characteristic gastropod-lamellibranch limestone, 4 ft. thick, is well seen in the stream 1 mile west of Blakehopeburnhaugh, while a gritty bed, highly crinoidal in its upper part, crops out three-quarters of a mile south of Ellis Crag.

Turning to the Falstone country, the Plashetts Coal has been wrought from Shipley Shields to the Black Burn : higher upstream is a crinoidal limestone, and at a still higher level the Piper's Cross Limestone. The latter is again seen at the Belling quarries, half a mile to the south, passing down into a shelly sandstone—a characteristic feature of this well-known bed. Of other strata there are good exposures in the Cat Cleugh burn at John Side, $1\frac{1}{2}$ miles north-east of Greenhaugh, where five thin cement-like bands of marked Scremerston type can be seen : there is a 12-in. coal in the Tarret Burn below. These measures must be faulted against the higher beds seen so well in Sundaysight Cleugh. Several hundred feet of strata are clearly seen here, with five crinoidal limestones, and yet so imperfect is our knowledge of this difficult country that as yet we are by no means sure even of their general position. The original surveyors held that they were fault-repetitions of Redesdale-Fourlaws strata, but there is reason to think that in reality we are dealing with an unfaulted sequence whose horizon has yet to be determined.

Carboniferous Limestone Series.—Around Kirkwhelpington (one-inch Sheet 14) Mr. Burnett was for the most part engaged on the Lower and Middle Limestone Groups of that district. The leading horizons from the Great Limestone down to the Oxford all appear here, but certain changes from their development in the Alnwick-Belford country require notice. The Great Limestone, 45 ft. thick, is, as elsewhere, liable to dolomitization, but it is much darker, and compound corals are rare.

The Eight-Yard (Sandbanks) Limestone has improved in quality, and the higher posts abound in *Saccamminopsis* (*Sacca-mina*) *fusulinaformis*, a foraminifer characteristic of the Acre Limestone in the Belford country, but moving upwards to the Eight-Yard south of Alnwick. The Acre and Eelwell are dark crinoidal limestones, by no means so well characterized as in the Alnwick-Belford region. The most striking fossil-band is that covering the first limestone below the Eelwell, where *Spirifer* and *Orbiculoidea* abound. Immediately below is a branch of the Whin Sill, steadily retaining this position for quite four miles south of Kirkwhelpington.

The Oxford Limestone is full of *Girvanella*-like nodules, thus retaining the special feature so well seen in all the north Northumberland districts.

R. G. CARRUTHERS.

(B)—SCOTLAND

1. DUMFRIESSHIRE

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DURING the past field season the revision of the post-Silurian rocks of one-inch Sheet 15 was continued. The Lower Old Red Sandstone lavas and sediments north-west of the Southern Upland Fault near the head of the Duneaton Water were re-mapped by Mr. Ross during the summer. Later in the year his work was carried southwards by Mr. A. G. MacGregor, who also investigated the Spango Granite south-east of the fault. At the same time Messrs. Richey and Simpson were engaged in the survey of the Sanquhar Coalfield in areas respectively east and west of Kirkconnel. Mr. Richey also re-mapped a portion of the Thornhill Basin.

Dr. J. Pringle as palaeontologist continued his examination of the musselbands and marine beds in the Coal Measures and underlying Lower Carboniferous strata of Sanquhar and Thornhill, and some of his results are incorporated in the report below.

Spango 'Granite'.—The intrusion is a biotite-hornblende-granodiorite.¹ Both grey and reddish varieties are met with, the reddening being due to the staining of decomposition products in the plagioclase-felspars. Microscopically the rock closely resembles the Distinkhorn granodiorite that cuts Lower Old Red Sandstone strata near Darvel.²

The granodiorite contains numerous inclusions of greyish dioritic rocks composed of the same minerals as the main intrusion. The inclusions are, however, finer in grain and richer in biotite and hornblende, and occasionally contain a pale bluish green monoclinic pyroxene. The plagioclase-felspars (zoned andesine) often show the peculiar clouding typical of the felspars of thermally metamorphosed igneous rocks.³ The majority of the inclusions are small, but there are two large masses about 200 yds. across. They have been found in the Gareland Burn near the Southern Upland Fault, and on the Lanarkshire-Dumfriesshire boundary at the north end of Fingland Rig. The inclusions probably represent fragments of a relatively basic earlier intrusion caught up in the granodiorite.

¹ Walker, F., 'The Plutonic Intrusions of the Southern Uplands East of the Nith Valley,' *Geol. Mag.*, 1928, p. 158.

² MacGregor, A. G., in 'The Geology of North Ayrshire' (*Mem. Geol. Surv.*), 1930, pp. 47-49.

³ MacGregor, A. G., 'Clouded Felspars and Thermal Metamorphism,' *Mineralogical Mag.*, vol. xxii, 1931, pp. 524-538.

A small isolated intrusion on Knockenshag, just west of the main Spango mass, proves to be a quartz-hornblende-biotite-diorite of variable grain. The hornblende is reddish brown in colour, and contrasts with the olive-green hornblende of the granodiorite.

The metamorphic aureole varies from about 600 to 1,100 yds. in width. The Ordovician sediments have been recrystallized with the development of green hornblende and reddish brown biotite as ferromagnesian constituents. As was observed by Jack,¹ the Southern Upland Fault cuts out part of the Spango intrusion and its hornfels aureole. No dykes were found in the granodiorite and there are very few in its neighbourhood. A north-easterly acid dyke, cutting highly baked sediments close to the Knockenshag diorite, shows no sign of contact-alteration.

Millstone Grit?.—Along the southern margin of the Sanquhar Coalfield the unconformable junction of the Carboniferous beds with the underlying highly folded Ordovician greywackes and shales is seen in a number of sections. The Ordovician rocks immediately below the unconformity are weathered to a greyish white or yellowish clay to a depth of a few feet. From this source some of the material constituting the lowest Carboniferous beds has presumably been derived. A clay matrix, which varies greatly in amount, is typical of much of the basal Carboniferous sandstones, and occasionally beds of clay are developed, which resemble the Ayrshire Bauxitic Clay.² The purer clays are dense, solid rocks, breaking with a conchoidal fracture, and containing veins and blebs of kaolin. Good examples are exposed in the Barr Burn $1\frac{1}{2}$ miles west-south-west of Sanquhar, and in the Kello Water and Polhote Burn, respectively south and west of Kirkconnel.

The bauxitic clays occur a short distance above the basal unconformity. Higher in the sequence there is a bed of shale with ironstone bands, containing marine fossils, first discovered by Mr. D. Tait, in 1913, in the Polneul Burn, 2 miles west-south-west of Kirkconnel. This marine position lies about 25 feet above the bauxitic clays, and 80 feet below a musselband containing *Carbonicola pseudorobusta* Trueman, a typical fossil of the Ovalis Zone. It has also been located in the adjoining Polbroc Burn. Near Sanquhar, in the Barr Burn, a marine bed near or at the same horizon almost directly overlies bauxitic clay.

The following fossils have been collected by Messrs. Tait, Fisher and Pringle from the Polneul Burn: Crinoid stems, *Ambocoelia urei* (Flem.), *Buxtonia scabricula* (Mart.), *Cleiothyridina royssi* (Dav. non Lèveillé), *Lingula mytiloides* J. Sow., *Orbiculoidea nitida* (Phill.), Orthotetid, *Productus* cf. *productus*

¹ Jack, R. L., in 'Explanation of Sheet 15' (*Mem. Geol. Surv.*), 1871, p. 17.

² Wilson, G. V., 'The Ayrshire Bauxitic Clay' (*Mem. Geol. Surv.*), 1922, pp. 9, 24. J. B. Simpson in 'Summary of Progress for 1930,' Part i (*Mem. Geol. Surv.*), 1931, p. 61.

J. Sow., *Schizophoria resupinata* (Mart.), *Spirifer* spp., *Allorisma sulcata* (Flem.), *Aviculopecten* spp., *Palaeolima* cf. *simplex* (Phill.) and *Bellerophon* sp.

From the Barr Burn, in addition to species of *Productus*, *Protoschizodus* and *Loxonema*, Mr. Eckford obtained the following plants: *Sphenopteris* ?, *Zeilleria moravica* (Ett.), named by Dr. Crookall, and *Lepidodendron* sp.

The stratigraphical position of the marine bed is considered by Dr. Pringle to be Lower Carboniferous, and both it and the underlying strata, including the bauxitic clays, may represent the lower part of the Scottish Millstone Grit. If so, the marked palaeontological break taken as the dividing-line between the Lower and Upper Carboniferous in Scotland must lie above the marine band and below the lowest 'mussel' bed of the Ovalis Zone.

Coal Measures.—These strata are excellently exposed in practically every tributary of the River Nith traversing the Sanquhar basin, and include a number of musselbands. All the 'mussel' zones from that of *Carbonicola ovalis* up to that of *Anthracomya phillipsi* have been recognized. In the lower, Productive Measures, the three coal seams worked at present are, in ascending order, the Splint, the Calmstone, and the Creepie. Below the Splint a number of thinner seams, collectively termed the Swallowcraig Coals, lie in the Ovalis Zone, as shown by the occurrence of musselbands containing *Carbonicola pseudorobusta* Trueman. The coals are well exposed at Corserig in the Polbroc Burn, $1\frac{1}{2}$ miles south-west of Kirkconnel, and in the vicinity of the Kello Water. The Splint Coal is associated with musselbands that indicate a position within the Modiolaris Zone. Below and also above the seam in the Polneul Burn just south of Nether Cairn farm fossils collected include *Carbonicola* cf. *communis* D. and T., *C.* aff. *concinna* Wright, *C.* cf. *phrygiana* Wright, *C.* aff. *similis* (Brown) and *Naiadites* aff. *producta* (Brown). Prof. A. E. Trueman, who named the fossils from this locality, has suggested that several of the smaller shells should be referred to *C. elliptica* Wright. A few feet above an outcrop of the Splint Coal in a stream (Catcleugh Burn), 500 yds. west of Towerhill, additional forms obtained are: *Carbonicola* cf. *carissima* Wright, and *Naiadites* cf. *modiolaris* (J. de C. Sow.). These occur in association with *Neuropteris heterophylla* Brongn. and *Calamites* sp.

Between the Splint and the Calmstone coals, a number of musselbands of the Similis-Pulchra Zone have been located. The sequence includes two coals that have been locally worked, the Daugh and the Twenty Inch. Just above a bed of parrotly shale correlated with the Daugh in a burn 300 yds. north-east of Low Connelbush farm, $1\frac{1}{2}$ miles west of Sanquhar, a musselband ironstone is crowded with shells, somewhat poorly preserved. These include the following: *Carbonicola acutella* Wright, *C.* sp. [*aquilina* group] and *Naiadites* cf. *quadrata* (J. de C. Sow.). Shells

resembling *Anthracomya pulchra* Hind were noted in shales underlying the coal horizon. Shales a few feet above an old mine to the Twenty Inch Coal in Bridge-end Cleugh, north-west of Crawick, yielded a large number of 'mussels,' including *Anthracomya*?, *Carbonicola* aff. *concinna* Wright, *C. cf. similis* (Brown), *Naiadites cf. carinata* (J. de C. Sow.) and *N. quadrata* (J. de C. Sow.).

The strata between the Calmstone Coal and Skipsey's Marine Band at the top of the Productive Measures are well exposed in a number of sections, for example, in the Polmeur, Rig and Lagrae burns west of Kirkconnel. Musselbands are scarce in this part of the sequence, but from the Lagrae Burn, 60 feet above the Creepie Coal, the following fossils were obtained: *Carbonicola* cf. *aquilina* (J. de C. Sow.), *C. regularis* Trueman, *Naiadites* sp., and *Spirorbis pusillus* (Mart.).

Skipsey's Marine Band,¹ first discovered in the Sanquhar Coalfield by Mr. A. Wilson, sen., of Sanquhar, has proved of special value in the development of the mining field near Kirkconnel. A new outcrop was located by Mr. Simpson in the Glenwharrie Burn, 700 yds. north of Glenwharrie farm, and provides an important datum for determining the geological structure in an area not yet mined or bored. Of a large fauna collected from all localities, the following are specially noteworthy: *Posidoniella sulcata* Hind, *Pterinopecten papyraceus* (J. Sow.), *Homoceras* *toides jacksoni* Bisat, *Metacoceras costatum* (Hind), *M. perelegans* Girty, and spines of *Listracanthus wardi* A. S. Woodw.

Barren Red Measures occupy much of the northern portion of the Sanquhar basin, and northwards of Kirkconnel there are upwards of 600 feet of these beds. In this district basal grey measures with thin coal seams are succeeded at about 150 feet above Skipsey's Marine Band by alternating red and grey beds, which continue for some 330 feet. Overlying strata are uniformly tinted purplish red. At Sanquhar, however, in quarries at the brickworks, reddening affects strata only a short distance above the Calmstone Coal. It seems probable, from a comparison of thicknesses with those of Ayrshire,² that the Barren Red Measures present lie wholly within the Phillipsi Zone, and do not include the overlying Tenuis Zone. *Anthraconauta* [*Anthracomya*] *phillipsi* (Will.), together with *Estheria* (*Euestheria*) *simoni* Pruvost, has been obtained from two horizons near Kirkconnel, near the base and top of the alternating grey and red measures about 180 feet and 500 feet above Skipsey's Marine Band. The localities are: from grey shale overlying red marl in the Tower Burn 600 yds. north of Tower farm; and from the roof of a coal in the Polbower Burn 600 yds. downstream from Kirkland farm.

Glacial.—An extensive ice-movement towards the east already demonstrated in the south of Ayrshire³ is now proved to have con-

¹ Clough, C. T., in 'Summary of Progress for 1909' (*Mem. Geol. Surv.*), 1910, pp. 77-78.

² Pringle, J., and W. Manson, 'Anthracomya phillipsi in the Barren Red Measures of Ayrshire,' *The Naturalist*, 1929, p. 267.

³ Eyles, V. A. and J. B. Simpson in 'Summary of Progress for 1925' (*Mem. Geol. Surv.*), 1926, pp. 101-102.

tinued down the Nith valley to beyond Sanquhar. In the boulder-clay between New Cumnock and Sanquhar boulders of kyllite have been noted at a number of places. Their source lies to the west in the sills of the kyllitic suite near Dalmellington. Boulders of grey biotite-granite resembling the Loch Doon and Cairnsmore of Carsphairn masses are frequent.¹ A boulder of hornblende-peridotite, belonging to the Lugar Sill, was found by Mr. Ross in a tributary to the Laird's Burn, $5\frac{1}{2}$ miles north of Kirkconnel, and also indicates movement from the west. A few drumlins trending in a general west-east direction have been noted near Kirkconnel.

The final retreat of the ice is marked in the Nith valley by deposits of gravel and by drainage channels.² The gravels are distributed in an irregular manner along the floor and sides of the valley up to 200 feet above the present river level. The drainage channels slope down towards the east. They were undoubtedly formed marginally to ice retreating westwards, and we are unable to reconcile our mapping of the upper part of the Nith valley with that indicated by Professor Charlesworth.³

At Sanquhar abundant pebbles of Spango Granite in the gravels, derived from the Crawick Water valley, show that materials were to some extent obtained from sources in the hills adjoining the Nith valley, which must have been, in part at least, free of ice during the retreat of the Nith glacier.

J. E. RICHEY.

¹ *Op. cit.*, Fig. 10.

² Simpson, J. B. in 'Summary of Progress for 1930,' Part i (*Mem. Geol. Surv.*), 1931, p. 62.

³ Charlesworth, J. K., 'The Glacial Geology of the Southern Uplands of Scotland, West of Annandale and Upper Clydesdale,' *Trans. Roy. Soc. Edinburgh*, vol. lv, part i, 1926, p. 14 and map.

2. CENTRAL COALFIELD

T. ROBERTSON, B.Sc., Ph.D., A.Inst.M.M., Senior Geologist.

A REVISION of the field and mining work in the Kilsyth district, in preparation for publication of the economic memoir on Area I of the Central Coalfield, has been undertaken.

Throughout the sequence in the Upper Old Red Sandstone area of the Garrel Burn the cornstones and pebbly sandstones were found to contain wind-faceted pebbles, including well-formed dreikanter. Such pebbles are numerous at some horizons, especially near the top; and the associated sandstones contain a large proportion of well-rounded grains.

In the Carboniferous Limestone Series, the Johnstone Shell-bed has been satisfactorily traced throughout the area, and forms, as elsewhere, a reliable index-horizon for the base of the main coal-bearing strata. It lies some 16 to 20 fathoms below the Kilsyth Coking Coal. Other noteworthy points in the succession are a well-developed *Lingula*-bed overlying the Kilsyth Coking Coal,¹ several 'mussel' beds associated with the coals, and the presence in the Cumbernauld area of the Huntershill Cement as a shelly bed overlying the Bishopbriggs Sandstone. Bores at Dullatur and Wester Gartshore have yielded goniatites from the Upper Limestone Group (*see* p. 25), and the evidence suggests that the base of the higher division of the Eumorphoceras Zone (E₂) may be as low as the shales overlying the Index Limestone.

The quartz-dolerite sills in the district are extensively worked for road-metal and sett-making. They have received attention from the economic point of view, and their relationship to the somewhat complicated structure of the Kilsyth Coalfield is under further investigation.

T. ROBERTSON.

¹ This is probably the *Lingula*-bed found in neighbouring areas and correlated with the Maich Shell-bed of North Ayrshire; *see* M. Macgregor, *Trans. Geol. Soc. Glasgow*, 1930, vol. xviii, part iii, p. 256.

3. FIFE

J. K. ALLAN, M.A., B.Sc.	} Geologists.
J. KNOX, B.Sc.	

MESSRS. Allan and Knox continued the revision of the Dysart and Leven Coalfield and completed the survey of the area for the third and final memoir of the series describing the economic geology of the Fife Coalfields. Some work was also done in the six-inch Sheets adjoining this area for purposes of correlation. Mr. Knox surveyed that part of the ground that lies west of a line between Methil and Kame Bridge, while Mr. Allan worked eastwards to Largo Law. Through the courtesy of the mining companies some 300 bore and pit sections were collected, and a large number of mining plans examined.

The strata throughout the area are involved in the north-north-east system of folding observed farther west in the Dunfermline-Cowdenbeath district, and are traversed by a number of large faults which run approximately at right angles to the axes of the folds. The Largo Fault, extending from near Toddy Bridge to the coast at the east end of Lower Largo, marks the northern limit of the Leven Coalfield, while the Kilmux Fault between Star and Nether Pratis forms the northern boundary of the Limestone Coal Group of the Kilmux and adjoining coalfields.

Carboniferous Limestone Series.—Rocks of the Limestone Coal and Upper Limestone groups occupy all the northern part of the area. The Limestone Coal Group in the Kilmux field has a thickness of 670 to 750 ft. and includes 6 or 7 workable coals, but farther east the complete succession is not yet known. The upper part of the Upper Limestone Group is exposed in Kennoway Den, north-west of the village, where it includes two beds of limestone separated by about 100 ft. of strata. The higher of these limestones is undoubtedly the Castlecary, and this horizon has also been identified in a boring near Balgrummo farm, on the north side of the Durie Fault that runs from Star to the coast between Silverburn and Lundin Links. It is seen again in Hatton Den, on the north side of the Largo Fault, on both sides of a narrow syncline. A thin limestone associated with marine shales lying about 100 ft. below the Castlecary in Hatton Den can probably be correlated with the lower limestone of Kennoway Den. These limestones were formerly taken to represent the Calmy Limestone¹ but almost certainly lie at a somewhat higher horizon in the position of one of the Pleian Limestones of north-east Stirlingshire. Other outcrops of Upper Limestone Group strata can be seen in Keil Den and on the shore at Viewforth, Largo, where Kirkby found a

¹ See 'Geology of Central and Western Fife and Kinross' (*Mem. Geol. Surv.*), 1900, p. 135 and 'Geology of Eastern Fife' (*Mem. Geol. Surv.*), 1902, pp. 180-181.

calcareous shale with abundant marine organisms which he tentatively placed at or near the Index Limestone position.¹ The total thickness of the Group is estimated to exceed 800 ft.

Millstone Grit.—The lower part of the Millstone Grit is seen in the southern part of Kennoway Den where the sandstones and grits of the series are pierced by a small ash vent. Where exposed in Aithernie Den, north of the Durie Fault, the succession includes a lava-flow and some bands of ashy sediments. In Hatton Den the Castlecary Limestone is succeeded by a bed of blaes overlain by several thick posts of sandstone with shaly partings.

Coal Measures.—These measures are confined to the region south of the Largo Fault, and while the general dip is eastwards they are involved in the same system of folding that has affected the lower members of the Carboniferous system. Several large faults with downthrow to the south traverse them in an east-west direction and displace their outcrop so that they appear at the surface as far east as Lundin Links. The complete succession is known in the west at East Wemyss, where the thickness from Skipsey's Marine Band (see below) to the Seven Foot Coal is about 1,560 ft. This is reduced to 1,260 ft. at Wellesley Colliery, and appears to be still smaller at Leven and Durie collieries where, however, only the upper portion has been fully proved.

Barren Red Measures.—The Barren Red Measures occupy the coast from Wemyss to Temple, except for a small stretch at Lundin Links where the upper beds of the Coal Measures are brought to the surface on the north side of the Durie Fault. Their lower part can be seen in Letham Glen to the south of Cuffabout, where one of the ochre beds characteristic of this portion of the sequence has been worked from a shallow pit.

The base of the Barren Red Measures in East Fife is now drawn immediately above the marine horizon that was discovered by Kirkby² many years ago, at the following localities: (a) Denbeath (Wellesley) Colliery; (b) the ravine at East Wemyss; (c) the fore-shore opposite Wemyss Castle. Both on stratigraphical and faunal grounds, this marine horizon is considered to be the equivalent of Skipsey's Marine Band of the Central Coalfield.³ A list of fossils recently collected from the Wemyss exposures is as follows:—

Ravine, East Wemyss
Lingula mytiloides J. Sow.
Productus sp.
Spirifer sp.
Edmondia ?
Metacoceras costatum (Hind)
Goniatite
Orthoceras sp.
Petalodus sp.

Shore, Wemyss Castle
Lingula mytiloides J. Sow.
Strepsodus sauroides Binney

¹ See 'Geology of Eastern Fife' (*Mem. Geol. Surv.*), 1902, p. 180.

² Kirkby, J. W., 'On the Occurrence of Marine Fossils in the Coal Measures of Fife,' *Quart. Journ. Geol. Soc.*, vol. xlv, 1888, p. 747.

³ See C. T. Clough, 'The Marine Beds near the Base of the Upper Carboniferous Red Barren Measures of Scotland,' in 'Summary of Progress for 1907' (*Mem. Geol. Surv.*), 1908, pp. 127-136.

In addition to the above Kirkby recorded from the shore section '*Bellerophon urei*' with '*Diplodus gibbosus*' and other fish-teeth.¹

It should be noted that Kirkby placed this marine band 210 ft. above the Barnraig Coal, and drew the base of the Barren Red Measures 40 ft. above it.²

The ferruginous bed, containing fish-teeth and poorly preserved lamellibranchs, found on the shore at Lundin Links, must be very near the marine band of Wemyss. The Barren Red Measures are composed in the main of red and purple sandstones, fireclays and marls, with several ochre beds near the base, and are known to reach a thickness of at least 500 ft.

Superficial Deposits.—The greater part of the area is covered by a thick deposit of boulder-clay overlain in the north-west by wide spreads of sand and gravel which appear to have come from the north through the Falkland gap. Along the coast remnants of three Raised Beach platforms have been mapped. Between East Wemyss and Buckhaven a distinct notch is cut in the boulder-clay at a level of about 112 ft. above O.D. Below this notch stretches a gently sloping platform covered by fine sand with lenticles of stoneless clay. These deposits are considered to belong to the 100-ft. Raised Beach. East of Buckhaven the inner margin of this beach is obliterated by spreads of gravelly sand of fluvio-glacial origin, which in places cover the greater part of the platform. A second notch can be traced along the whole coast-line at a level of approximately 30 ft. above O.D., marking the inner margin of the sands of the 25-ft. Raised Beach. Much of this platform is covered by blown sand, particularly east of Leven. In the valley of the River Leven and eastwards to Lundin Links, a sandy flat with its inner margin at 75 ft. above O.D. marks the position of an intermediate beach (the '50-ft.' Raised Beach).

J. K. ALLAN.

J. KNOX.

¹ Kirkby, J. W., *op. cit.*, p. 749.

² Kirkby, J. W., *op. cit.*, pp. 748, 749.

4. SHETLAND

G. V. WILSON, B.Sc., District Geologist.

J. PHEMISTER, M.A., D.Sc. } Senior Geologists.
D. HALDANE, B.Sc.

A LATE field season was undertaken in Shetland by the above-named members of the staff. Dr. Phemister was engaged mainly in the Colla Firth district of North Maven, Mr. Haldane in the area between Mangaster Voe and Roe Sound, and Mr. Wilson in the south-west portion of Sandsting. All these districts lie to the west of a north-and-south line which extends from the east side of North Roe through Brae, Aith Voe and Seli Voe to the east of Rea Wick. At its southern end this line is a well-marked fault, best seen at an exposure on the south coast of Bixter Ness, where it separates the Old Red Sandstone sediments of the Walls Peninsula from the metamorphic rocks which lie to the east.

Most of the area surveyed consists of sediments and intrusive rocks which presumably belong to the Old Red Sandstone period. The sediments of the Sandsting district were found to consist mainly of highly siliceous, fine-grained sandstones with occasional flaggy and limy bands. They are generally in an indurated and altered condition, and in some localities the rocks are hardened and shattered to such an extent that it is impossible to ascertain the direction of dip. Between Olas Voe and Bixter Voe the beds are found to have a general inclination to the east-north-east at angles varying from about 10 degrees to vertical. On the north shore of Bixter Voe and in the cliffs at Roe Ness to the south of Rea Wick, however, westerly dipping strata were noted, and the beds found to be acutely folded. At one or two localities finely-stratified sandy beds have been seen to be compressed into minute contortions whose axes lie parallel to the dip.

The intrusive igneous rocks consist essentially of various dioritic and granitic types, and, whereas in Sandsting they are found to be intruded into sediments of Old Red Sandstone age, farther north, in the areas mapped by Dr. Phemister and Mr. Haldane, they have only been noted in contact with rocks belonging to the metamorphic series.

Wherever it has been examined the diorite is found to vary greatly in composition and texture. The change can be seen to take place within a few yards, but the intervening ground is often obscured. The most usual type is a rather fine-grained greyish or pinkish rock, but coarse-grained varieties are common and sometimes the rock approaches to a gabbro in composition. The cause of these variations has not yet been made out, but a certain amount of evidence has been gathered near Hestinssetter Hill which suggests that it may in some cases be due to banding.

Normal contacts of the diorite with the country rocks have only been observed at two localities, against hornblende-schist on the north side of Roe Sound and against sandstone near the Loch of Sotersta in Sandsting. At both places the margin is very irregular, but tongues of diorite can be seen intruded along the strike of the older rocks. Included masses of sandstone have been noted to the north of the Broch¹ of Culswick and of schistose rocks in the Ness of Houll.

The granitic rocks from the different districts vary considerably in composition and texture. Those from Ronas Hill and Muckle Roe may be described as drusy red granophyres, poor in ferromagnesian minerals. In the Sandsting area several separate intrusions have been noted; the most widely developed is a rather coarse rock with porphyritic felspar crystals and a fair amount of biotite and hornblende. Others are finer grained, non-porphyritic and poor in ferromagnesian constituents.

The field relations of the various granite masses are less obscure than those of the dioritic intrusions. For instance, the margins of the Ronas Hill granite are found to cut sharply across the foliation of the adjacent schists. Further, wherever the contact is exposed, it has been found to be vertical or nearly so. At the low crags along the foot of the Beorgs of Skelberry fragments of schist can be seen welded on to the granite margin. A separate dyke-like, xenolithic intrusion of granite has been traced for a distance of fully three miles along the south-eastern border of the main granite. Between Skelberry and the bridge at Colla Firth it is 200 ft. wide, but east of Collafirth Hill it appears to split and forms a zone of granite, xenolithic granite and schist about 800 ft. in width. The xenoliths are angular in form, consist mainly of siliceous and muscovite-bearing schist and occasional fragments of hornblende-schist, and are in a more highly altered state than the schists along the margin of the main granite. At, and north-north-east of the bridge at Colla Firth, the edge of the main granite contains rounded xenoliths of a bluish grey felsitic rock. The fragments are all of one type and bear no resemblance to those of the adjacent xenolithic dyke. On examination they are found to contain phenocrysts of pink felspar, rounded hornblendic and epidotic spots and oval drusy cavities which are thought to represent altered amygdales. These are usually filled with acicular crystals of hornblende, though epidote may also be present.

In Sandsting the northern margin of the granite which occurs to the west of Skelda Voe is found to dip normally below the overlying sediments at the Bight of Selistack, near the entrance to Gruting Voe. Eastwards from there the boundary passes by Girvet's Loch to the east side of Gossa Water, and appears to represent a definite top to the intrusion. The position of the base is more doubtful; it is, perhaps, represented by the boundary

¹ Brough on the one-inch map of Scotland, Sheet 125.

which has been traced from the west side of the Loch of Sotersta to the head of the Culswick valley. If such is the case the granite exposed along the coast to the west of the Stead of Culswick is most probably a separate intrusion. It also seems possible that the north-westerly dipping sequence, seen between there and Olas Voe, of granite, sandstone, diorite, sandstone, granite, sandstone represents the actual upward succession of the rocks. A little higher in the series a number of thin granitic sills are to be seen in the coast section of Hoga Ness.

Farther to the east, two other acid intrusions with definite sill-like characters have been noted. The more westerly one extends from Effirth Voe southwards to Roe Ness; the other occurs about a quarter of a mile still farther east and has been traced from the shores of Effirth Voe to beyond the Laxa Burn. The coastal exposures of both these intrusions show the igneous rock finger-ing out into the adjoining sediments.

The relative ages of the dioritic and granitic types are difficult to determine. Many of the junctions are vertical, and they often show signs of movement. It may be stated, however, that the diorite is almost always found to be cut by veins and strings of granitic materials, but as yet no instance has been noted where granite is seen cut by strings of diorite.

The various granitic sheets are no doubt of different ages, and it seems possible that some of the vertical granitic masses that are found cutting the diorite represent the feeders of some of the higher granite sheets.

The granites of North Roe and Muckle Roe are cut by a suite of dykes with a general north-and-south trend. It includes basic and acid types. Among the latter are porphyrites, granite-porphyrries, quartz-porphyrries, and felsites. Many of the felsites are banded, and they may be either white, pink, brown or blue in colour. The two last varieties are restricted to North Roe and commonly exhibit spherulitic structure. The porphyrite dykes appear to be the oldest and the blue felsites the youngest of the suite, but as yet no evidence as to the relative age of the granite-porphyrries has been obtained.

Zones of shattered rock are an interesting feature of the granitic and dioritic intrusions. In some instances they occur as vertical smashes which usually trend a little west of north. On examination they have been found to consist of crushed granitic, dioritic and vein quartz materials. Examples of this type are to be seen at Skelda Ness and along the shores of Wester Wick, where they had previously been noted by Dr. Finlay.¹ In other cases wide areas of crushed and indurated material of both igneous and sedimentary origin are found between adjoining dioritic and granitic masses. The more interesting examples are to be seen in the

¹ Finlay, T. M., 'The Old Red Sandstone of Shetland, Part II, North-Western Area,' *Trans. Roy. Soc. Edin.*, vol. lvi, 1930, p. 686.

vicinity of Culswick village and on the hill about a quarter of a mile east of Housa Water. The third type of crushing affects wide areas and is well exemplified in the country between Rea Wick and Skelda Voe. In this district the sediments are acutely folded. It seems probable, therefore, that while the latter were able to accommodate themselves to the folding movements the harder and more brittle granite became intensely fractured.

G. V. WILSON.

III. SECTIONAL REPORTS

I. PALAEOONTOLOGICAL DEPARTMENT

In London

F. L. KITCHIN, Sc.D., Ph.D., F.R.S., Palaeontologist
(District Geologist).

C. P. CHATWIN, M.Sc., Assistant-Palaeontologist
(Senior Geologist).

C. J. STUBBLEFIELD, Ph.D., A.R.C.Sc., Geologist.

In Edinburgh

J. PRINGLE, D.Sc., Assistant-Palaeontologist
(Senior Geologist).

A. ENGLAND AND WALES

AN outline of the general work done in this Department during the year has been given above, in the Report of the Director (p. 27). The following few items of scientific interest seem worthy to be noticed here.

A collection of fossils obtained by Mr. W. Dewar from a nodule-bed in the Lower Greensand of Sandy, Bedfordshire, proved of interest. The specimens, which were examined by Mr. Chatwin, were all found to be in the state of worn casts, and in many cases both these casts and the nodules containing them are extensively bored by burrowing animals. In some instances remains of the boring lamellibranch *Lithodomus* (or *Lithophagus*) are to be seen in their excavations. Fragments of ammonites are the most common of the fossils, the remainder, with the exception of a single example of *Pleurotomaria*, being all lamellibranchs. Most of the ammonite-fragments are referable to *Pavlovia rotunda* (J. Sowerby), from the Kimmeridge Clay, but the collection also includes three fragments of *Pavlovia pallasioides* (Neaverson) and two of *P. aff. pavlovi* (Michalski). Only the Rotunda and Pallasioides Zones are represented among the fossils, that is to say, the beds which in Buckinghamshire are known as the Hartwell Clay. The lamellibranchs, which include, with others, the genera *Isocardia*, *Astarte*, *Trigonia*, *Pecten* (*Camptonectes*), *Protocardia*, and *Pleuromya*, are of the forms common in that part of the Kimmeridge Clay. The bed in which the nodules occur, averaging about 6 inches in thickness, is of a rubbly character, and contains many lydite pebbles; it has yielded no contemporaneous fossils. It is interesting to note that it is not a basement-bed and, so far as can be seen, does not mark any transgression. It occurs some 100 ft. or more above the base of the Lower Greensand of that locality.

A set of fossils from the Lower Cretaceous beds penetrated in a boring at Westwood, Surrey, were found by Mr. Chatwin to include for the most part the usual long-ranged lamellibranchs, with a few brachiopods. He noted, however, that moulds of the Tetractinellid sponge *Geodites* are present at more than one level in the Hythe Beds.

During 1930 Messrs. A. Templeman and W. Dewar visited the working collieries in the Kent Coalfield for the purpose of collecting fossils from the Coal Measures. In the collection made from material brought up from the Tilmanstone Colliery shaft-sinking, Dr. Stubblefield has found specimens of the Conchostracan crustacean *Estheriella reumauxi* Pruvost, a species previously only recorded definitely from the Pas de Calais Coalfield,¹ where it occurs at comparable levels ranging from the Zone of *Anthraconauta* [*Anthracomya*] *phillipsi* to that of *A. tenuis*. From the Chislet Colliery collection he had identified the Arachnid species *Brachypyge carbonis* H. Woodward, which had hitherto only been recorded as occurring at various horizons in the Coal Measures of Belgium.

The selection of Ordovician fossils for the new stratigraphical exhibit has brought to light further evidence of faunal affinities between the $d_1\gamma$ horizon of the Bohemian sequence and the *Didymograptus bifidus* Zone of Britain.² Dr. Stubblefield has recognized in Survey collected material, not only from the Hope Shales of Shropshire, but also from the Lower Llanvirn Beds of South Wales, representatives of the highly specialized trilobite species *Ceratocephala* (*Selenopeltis*) *buchi* (Barrande) and *Symphysops monophthalmus* (Kloucek).³

The material collected by Mr. Templeman from a series of borings in the neighbourhood of Egremont, Cumberland, which has already acquired interest from the description, by Dr. Stanley Smith, of a new Stromatoporoid from the Seventh Limestone (S_2) occurring in certain of the cores,⁴ has been notable palaeontologically in another respect. In cores from five of these borings Dr. Stubblefield has identified the brachiopod *Davidsonina* [*Cyrtina*] *carbonaria* (M'Coy). Though well known at about the same stratigraphical level in Westmoreland and North Lancashire, this species has not previously been recorded from Cumberland. In two of the borings it was found at levels respectively 46 ft. and 63 ft. below that at which occurred *Labechia carbonaria* S. Smith.

¹ Tchernychev, B., 'Sur *Estheria* et *Estheriella* du bassin de Donetz,' *Ann. Soc. Paléont. de Russie*, vol. vi, for 1926, 1927, pl. vii, fig. 11, gives an unconvincing figure of a specimen named *E. reumauxi* Pruvost. The figures of *Estheriella varicostata* Tchernychev (pl. vii, figs. 12-14) resemble Pruvost's species much more closely.

² Hicks, H., 'On the Succession of the Ancient Rocks in the vicinity of St. David's, Pembrokeshire, with special reference to those of the Arenig and Llandeilo Groups, and their Fossil Contents,' *Quart. Journ. Geol. Soc.*, vol. xxxi, 1875, p. 174.

³ Kloucek, C., 'Ueber die $d_1\gamma$ Schichten und ihre Trilobitenfauna,' *Bull. Internat. de l'Acad. des Sci. de Bohême*, 1917.

⁴ Smith, S., '*Labechia carbonaria* sp. nov., a Lower Carboniferous Stromatoporoid from West Cumberland,' 'Summary of Progress for 1931,' Part ii (*Mem. Geol. Surv.*), 1933 [dated 1932 on title-page], p. 23.

A choice selection of the Tremadoc fossils discovered in the shales at Breadstone, Berkeley Road, Gloucestershire, by Dr. Stanley Smith, has been presented by him to the Museum. These specimens have been described by Dr. Stubblefield,¹ who finds that the fauna compares well with that of the lowest Tremadoc zone in North Wales.

The following specimens in the Museum have been figured, described, or mentioned in publications:—

IN THE PALAEONTOGRAPHICAL SOCIETY'S VOLUME FOR THE
YEAR 1930.

(Published 1932).

A Monograph of the Ammonoidea of the Gault. (Part ix).

By DR. L. F. SPATH, F.G.S.

Mortoniceras (*Pervinqueria*) *pricei* (*Spath*), p. 392 (2 specimens).

A Monograph of British Corallian Lamellibranchia. (Part iv).

By DR. W. J. ARKELL, M.A., B.Sc., F.G.S.

Grythaea dilatata *J. Sowerby*, var. *discoidea* [Seeley MS.] *H. B. Woodward and Kitchin*, pl. xx, fig. i, p. 162 (2 specimens).

Lima (*Plagiostoma*) *zonata* *Arkell*, p. 133.

IN THE QUARTERLY JOURNAL OF THE GEOLOGICAL SOCIETY,
VOLUME LXXXVIII.

The Palaeolithic Deposits of the Lower Thames Valley.

By MR. H. DEWEY, F.G.S.

Corbicula fluminalis (*Müller*), pp. 39, 45.

Pisidium amnicum (*Müller*), pp. 39, 45.

„ *astartoides* *Sandberger*, p. 39.

Sphaerium corneum (*Linnaeus*), p. 39.

Unio littoralis (*Lamarck*), p. 39.

Bythinia tentaculata (*Linnaeus*), p. 39.

Limnaea pereger (*Müller*), pp. 39, 45.

Planorbis umbilicatus *Müller* (= *marginatus* *Draparnaud*), p. 39.

Theodoxus crenulatus *Klein*, pp. 39, 45.

Valvata piscinalis (*Müller*), pp. 39, 45.

Ancylus fluviatilis (*Müller*), p. 45.

*A Fossiliferous Limestone associated with Ingletonian Beds at
Horton-in-Ribblesdale, Yorkshire.*

By PROFESSOR W. B. R. KING, O.B.E., M.A., F.G.S.

Triplecia insularis (*Eichwald*), p. 105.

Leptaena rhomboidalis (*Wilckens*), p. 105 (3 specimens).

¹ Smith, S., 'The Occurrence of Tremadoc Shales in the Tortworth Inlier, Gloucestershire,' with Notes on the Fossils collected, by C. J. Stubblefield, *Abstr. Proc. Geol. Soc.*, No. 1255, 1933.

*The Stratigraphical Distribution of the Cornbrash :*II. *The North-Eastern Area.*

By DR. J. A. DOUGLAS, M.A., F.G.S., AND DR. W. J. ARKELL,
M.A., B.Sc., F.G.S.

Dictyothyris bournensis Rollier, pl. x, figs. 3a, b, p. 149.

„ *elegans* Douglas and Arkell, pl. x, fig. 5, p. 150.

Microthyris sublagenalis (Davidson), pl. xi, fig. 1.

Lima (*Pseudolimea*) *duplicata* (J. de C. Sowerby), pl. xii, figs. 1, 1a, p. 160.

The British Carboniferous Reticulate Spiriferidae.

By DR. T. NEVILLE GEORGE, F.G.S.

Reticularia profecta T. N. George, pl. xxxii, figs. 1a-d, p. 565.

IN THE ANNALS AND MAGAZINE OF NATURAL HISTORY,
VOLUME VIII, TENTH SERIES.

On London Clay Crabs of the Family Raninidae.

By MR. M. F. GLAESSNER and MR. T. H. WITHERS, F.G.S.

Laeviranina glabra (H. Woodward), pl. xxi, figs. 3a, b, p. 485.

IN THE ANNALS AND MAGAZINE OF NATURAL HISTORY,
VOLUME IX, TENTH SERIES.

Some Observations on the Genus Naiadites.

By MISS E. DIX, M.Sc., F.G.S., AND PROFESSOR A. E. TRUEMAN,
D.Sc., F.G.S.

Naiadites sp. nov.?, (*aff. flexuosa* Dix and Trueman), pl. i, fig. 8, p. 15
(3 specimens).

„ *cf. obliqua* Dix and Trueman, pl. i, figs. 11, 12, p. 16 (2 specimens).

„ sp. nov., pl. i, figs. 16, 17, p. 18 (3 specimens).

„ *aff. producta* (Brown), text-fig. 4 ii, pp. 5, 6.

„ *cf. carinata* (J. de C. Sowerby), p. 10.

IN THE ANNALS AND MAGAZINE OF NATURAL HISTORY,
VOLUME X, TENTH SERIES.

Notes on Palaeocaris praecursor (H. Woodward), a Fossil
Crustacean of the Division Syncarida.

By DR. W. T. CALMAN, F.R.S., F.L.S., F.Z.S.

Palaeocaris praecursor (H. Woodward), text-figs. 1, 2, pp. 537-541 (8 specimens).

IN THE GEOLOGICAL MAGAZINE, VOLUME LXIX.

Notes on Two Species of the Genus Ampyx.

By DR. F. R. COWPER REED, M.A., F.G.S.

- Ampyx (*Lonchodomas*) *pennatus* [Salter MS.] *La Touche*, pl. xi, figs. 5-7, p. 205 (4 specimens).
 „ (*Raphiophorus*) *edgelli* *Reed*, pl. xi, figs. 1, 1a, 2-4, p. 207 (6 specimens).

IN THE PROCEEDINGS OF THE GEOLOGISTS' ASSOCIATION,
VOLUME XLIII.*The Quarternary Beaches of Gower.*

By DR. T. NEVILLE GEORGE, F.G.S.

Appendix A: The Marine Shells.

By MR. C. P. CHATWIN, M.Sc., F.G.S.

- Littorina littorea* *Linnaeus* (25 specimens), p. 317.
 „ *rudis* (*Maton*), (37 specimens), pp. 317, 318.
Neritoides obtusata (*Linnaeus*), (51 specimens), pp. 317, 318.
Patella vulgata *Linnaeus*, var. *intermedia* *Jeffreys* (3 specimens), p. 318.

IN THE TRANSACTIONS OF THE LEEDS GEOLOGICAL ASSOCIATION,
VOLUME V.*On Some Lower Sabdenian Goniatites.*

By MR. W. S. BISAT, F.G.S.

- Cravenoceras cowlingsense* *Bisat*, pl. i, figs. 1, 2, p. 29 (2 specimens).
 „ „ *cadicone* variant, pl. i, fig. 3, p. 29.
 „ *aff. edalense* *Bisat*, pl. i, figs. 4a, b, p. 33.
 „ *subplicatum* *Bisat*, pl. i, fig. 5, p. 30.
 „ *holmesi* *Bisat*, pl. i, fig. 6, p. 31.
 „ *stellarum* *Bisat*, pl. ii, fig. 1, p. 33.
 „ *nititoides* *Bisat*, pl. ii, fig. 2, p. 35.
 „ *fragilis* *Bisat*, pl. ii, fig. 4, p. 35.
 „ *kettlesingense* *Bisat*, pl. ii, fig. 5, p. 31.

IN THE MEMOIRS AND PROCEEDINGS OF THE MANCHESTER LITERARY
AND PHILOSOPHICAL SOCIETY, VOLUME LXXVI.*The Relative Value of Fossil Plants in the Stratigraphy of the Coal Measures.*

By DR. R. CROOKALL.

- Lepidophyllum intermedium* *Lindley and Hutton*, pl. i, fig. 1, p. 116.
Lepidocystis sp., pl. ii, fig. 4, p. 117.
Spiropteris sp., pl. ii, fig. 5, p. 117.
Linopteris obliqua *Bunbury*, pl. v, fig. 3, p. 119.
Neuropteris schlehani *Stur*, p. 107.

IN THE NATURALIST.

Non-Marine Lamellibranchs between the Better Bed Coal and the Elland Flags.

By MR. J. WALTON.

Carbonicola ovalis (Martin), pp. 121, 122.,, *communis* Davies and Trueman,, *aff. communis* Davies and Trueman—showing some approach to *C. polymontensis* (Brown)*Naiadites flexuosa* Dix and Trueman

IN BRITISH MUSEUM (NATURAL HISTORY)—

The Cephalaspids of Great Britain.

By PROFESSOR DR. ERIK ANDERSSON STENSIÖ.

Hemicyclaspis murchisoni (Egerton), *forma typica*, p. 77.,, *murchisoni* (Egerton), *var. ludlowensis* Stensiö, pl. x, fig. 1; pl. xxii, fig. 5, p. 84; and text-fig. 27, p. 83 (2 specimens).,, *lightbodii* (Lankester), p. 85 (6 specimens).? *Hemicyclaspis* sp., pl. viii, fig. 1.*Cephalaspis whitei* Stensiö, pl. xviii, figs. 4, 5; pl. xix, fig. 1, p. 93; and text-figs. 30 B, C, p. 94 (7 specimens).,, *pagei* ? Lankester, p. 100 (2 specimens).,, *powriei* Lankester, *var. brevicornis* Stensiö, pl. xxviii, fig. 2; pl. xxix, figs. 1-3; pl. lviii, fig. 2, p. 109; and text-fig. 36, p. 111 (3 specimens).,, *agassizi* Lankester, pl. xvi, fig. 4, p. 125 (2 specimens).,, *fletti* Stensiö, pl. xv, figs. 2, 4; pl. xvi, fig. 2, p. 127 (3 specimens).,, *watsoni* Stensiö, pl. xix, figs. 3, 4, p. 136; and text-fig. 48, p. 137 (2 specimens).,, *woodwardi* Stensiö, pl. xx, figs. 1, 2, p. 140; and text-figs. 50 A, B, p. 141 (2 specimens).

,, sp., pl. xxiii, fig. 1; pl. lvi, fig. 3; and text-fig. 54, p. 148.

Benneviaspis anglica Stensiö, p. 156.*Securiaspis kingi* Stensiö, pl. xlix, fig. 2, p. 162; and text-fig. 58, p. 163.

IN MEMOIRS OF THE GEOLOGICAL SURVEY. SUMMARY OF PROGRESS OF THE GEOLOGICAL SURVEY OF GREAT BRITAIN AND THE MUSEUM OF PRACTICAL GEOLOGY FOR THE YEAR 1931, Part ii.

(Issued January, 1933).

II.—*Labechia carbonaria* sp. nov., *A Lower Carboniferous Stromatoporoid from West Cumberland.*

By DR. STANLEY SMITH, M.A., F.G.S.

Labechia conferta (Lonsdale), pl. i, figs. 1-3, p. 27 (2 specimens and micro-slide).,, *carbonaria* S. Smith, pl. i, figs. 8-12, pp. 29, 30 (6 specimens and 7 micro-slides).

III.—*The Millstone Grit Succession in North Staffordshire.*

By MR. S. W. HESTER.

Reticuloceras reticulatum (Phillips), *mut. superbilingue* Bisat, p. 39 (2 specimens).

Anthracoceras paucilobum (Phillips), p. 45 (2 specimens).

Homoceras striolatum (Phillips), *cf. var. subglobosum* Bisat, p. 45.

Insect wings, p. 46 (8 specimens).

VI.—*The Stratigraphical Distribution of British Lower Carboniferous Plants.*

By DR. R. CROOKALL.

Volkmania morrisi Hooker, p. 90 (plaster cast).

Rhabdocarpus curvatus Kidston, p. 102.

VIII.—*Note on Reticuloceras reticulatum* (Phillips), *late mut. β Bisat.*

By MR. W. S. BISAT, F.G.S.

Reticuloceras reticulatum (Phillips), *late mut. β Bisat*, p. 121 (6 specimens).

IX.—*The Nature and Affinities of Palaeoxyris, etc.*

By DR. R. CROOKALL.

Palaeoxyris helicteroides (Morris), pl. ii, figs. 3, 4, pp. 128, 130 (3 specimens).

„ *helicteroides* ? (Morris), p. 130 (2 specimens).

Palaeoxyris sp., pp. 129, 130, 135 (11 specimens).

IN MEDDELELSER OM GRÖNLAND UDGIVNE AF KOMMISSIONEN FOR
VIDENSKABELIGE UNDERSÖGELSER I GRÖNLAND, BAND LXXXVII,
NO. 7. 1932. COPENHAGEN.

The Invertebrate Faunas of the Bathonian-Callovian Deposits of Jameson Land (East Greenland).

By DR. L. F. SPATH, F.G.S.

Tulites modiolaris (Smith), text-fig. 1a, p. 11.

Morrisiceras irregulare Spath, text-figs. 2a, b (2 views), p. 15.

Cadoceras modiolaris (E. T. Newton), p. 62.

„ *tolype* S. Buckman, p. 67.

Pleurocephalites folliformis S. Buckman, p. 72.

Gowericeras ventrale S. Buckman, p. 89.

„ *metorchum* S. Buckman, p. 90.

Toricellites approximatus S. Buckman, p. 90.

Galilaeiceras trichophorum S. Buckman, p. 95.

Inoceramus ? sp., p. 111.

Trigonia lingonensis Dumortier, p. 116 (2 specimens).

„ *hemisphaerica* Lycett, p. 116.

Quenstedtoceras lamberti (E. T. Newton), p. 140.

IN ARKIV FÖR ZOOLOGI, UTGIVET AV K. SVENSKA VETENSKAPSAKADEMIEN, BAND 24A, NO. 13. STOCKHOLM.

Notes on the Evolution and Morphology of certain Graptoloidea.

By DR. O. M. B. BULMAN, B.Sc., A.R.C.Sc., D.I.C., F.G.S.

Leptograptus latus Elles and Wood, text-fig. 1b, p. 8.

B. SCOTLAND

During the last three years important excavations in connexion with a drainage scheme were made across the site of the old Corstorphine Loch on the west side of Edinburgh. The progress of the work has been carefully followed by Mr. D. Tait, who, in addition to recording the details of the sections exposed at various points, has secured a representative set of arctic plants and associated animal remains. A preliminary examination of the plants has been made by Professor T. Johnson, who has recognized several of the commoner arctic species identified by the late Clement Reid in the material collected many years ago by James Bennie from the same lake-deposit. Among the animal remains obtained by Mr. Tait were included antlers of Red Deer and those of the Irish Deer.

During the autumn Dr. Pringle spent some time in the examination of numerous sections in the Sanquhar Coalfield and in the recently recognized Coal Measures of the Thornhill basin. He collected a large number of fossils, and found that there are present in the Sanquhar area the various zones characterized by species of freshwater Mollusca which form the basis of Messrs. Davies and Trueman's classification of the Coal Measures. From the Lower Carboniferous rocks exposed in the Barr Burn near Sanquhar, Mr. R. Eckford obtained an excellently preserved plant which has been identified by Dr. R. Crookall as *Zeilleria moravica* (Ettingshausen).

Reference has been made in the Report of the Director (p. 30) to the progress made in the registration of the fossils belonging to the Geological Survey which are exhibited in the galleries of the Royal Scottish Museum. The work has now been completed, and the collections have been further enhanced by the addition of many figured specimens. Of the John Smith Collection housed at Southpark, Edinburgh, Mr. E. M. Anderson has now registered more than 12,500 specimens, and he has also prepared a card-index of localities.

The following specimens have been figured in publications :—

IN THE GEOLOGICAL MAGAZINE, VOLUME LXIX.

The Scottish Species of Allagecrinus.

By MR. JAMES WRIGHT, F.G.S.

Allagecrinus austeni Carpenter and Etheridge, pl. xxiv, figs. 8, 14, 14a; text-figs. 1-4, p. 342.

„ *elongatus* J. Wright, pl. xxiii, figs. 18-20, 21, 23, 25-30, p. 352.

„ *garpelensis* J. Wright, pl. xxv, figs. 5, 7, 10, p. 346.

IN THE TRANSACTIONS OF THE ROYAL SOCIETY OF EDINBURGH,
VOLUME LVII.*Scottish Carboniferous Ostracoda.*

BY MISS MARY H. LATHAM, M.A.

- Paraparchites okeni* (Münst.), text-fig. 1, p. 354.
 „ *scotoburdigalensis* (Hibbert), text-fig. 2, p. 355.
 „ *inornatus* (M'Coy), text-fig. 3, p. 355.
 „ *armstrongianus* (Jones and Kirkby), text-fig. 4, p. 356.
 „ *superbus* (Jones and Kirkby), text-fig. 5, p. 357.
Ctenobolbina loculata Ulrich, text-fig. 6, p. 358.
Tribolbina carnegiei Latham, text-fig. 7, genotype, p. 358.
Hollina radiata (Jones and Kirkby), text-fig. 8, p. 360.
 „ *avonensis* Latham, text-fig. 9, p. 360.
 „ *longispina* (Jones and Kirkby), text-fig. 10, p. 361.
Janischewskya digitata Batalina, text-fig. 11, p. 365.
Sansabella arcuata (Bean), text-fig. 12, p. 366.
 „ *bradyana* (Jones and Kirkby), text-fig. 13, p. 367.
Kirkbya permiana (Jones), text-fig. 14, p. 368.
Ulrichia bituberculata (M'Coy), text-fig. 15, p. 368.
Amphissites urei (Jones and Kirkby), text-fig. 16, p. 369.
 „ *centronotus* (Ulrich and Bassler), text-fig. 17, p. 370.
 „ *radiata* (Jones and Kirkby), text-fig. 18, p. 371.
Glyptopleura costata (M'Coy), text-fig. 19, p. 372.
 „ *spinosa* (Jones and Kirkby), text-fig. 20, p. 372.
 „ *plicata* (Jones and Kirkby), text-fig. 21, p. 373.
 „ *spiralis* (Jones), text-fig. 22, p. 373.
Healdia cornigera (Jones and Kirkby), text-fig. 23, p. 380.
 „ *cuneola* (Jones and Kirkby), text-fig. 24, p. 381.

IN MEMOIRS OF THE GEOLOGICAL SURVEY. SUMMARY OF PROGRESS
OF THE GEOLOGICAL SURVEY OF GREAT BRITAIN AND THE MUSEUM
OF PRACTICAL GEOLOGY FOR THE YEAR 1931, Part ii.

(Issued January, 1933).

XI.—On three New Species of Fish from the Old Red Sandstone
of Orkney and Shetland.

BY PROFESSOR D. M. S. WATSON, F.R.S.

- Asterolepis orcadensis* Watson, pl. iv, fig. 1 (head-shield), and text-fig. 3,
 p. 162 (5 specimens used in reconstruction).
 „ *thule* Watson, text-figs. 4, 5, pp. 164, 165 (3 specimens).

F. L. KITCHIN.

2. PALAEOBOTANICAL WORK

IDENTIFICATIONS of fossil plants have been made from twelve one-inch Sheets and miscellaneous determinations have been made for the Palaeontological Department, the Bristol Museum, the Engineer of Chislet Colliery, Kent, for Mr. James Walton, of Brighouse, and others. Fossil woods have been examined as the specimens have been sent in. Certain plants sent in for examination are of particular interest as confirming the evidence of the fossil animals that beds of Lower Carboniferous age occur in the Sanquhar Coalfield.

Two visits have been made to the Kent Coalfield and one to the Bristol and Somerset Coalfield, many new records of fossil plants being obtained. Animal fossils, including insect wings, were collected incidentally at a number of localities, while rock specimens were obtained for exhibits. Reports on the palaeobotany of the Kent and Lancashire coalfields have been prepared. In the former, assistance was received from Professor P. Bertrand, of Lille, in correlating the measures with those of the north of France. In the preparation of an account of the lithology of certain fragile British coals, assistance was received from Mr. Maries of the Fuel Research Station.

Much time has been given in connexion with the exhibits for the new Museum. In addition to providing representative fossil plants from the various areas which include Carboniferous and other plant-bearing rocks, the Palaeobotanist is responsible for the exhibit illustrating the Bristol-Gloucester area and for the Coal Exhibit. Dr. F. B. A. Welch has spent a week in assisting with the former. Professor S. H. Reynolds has lent a number of negatives of geological interest, while the Director of the Bristol Museum and Art Gallery has presented 25 rock and fossil specimens for inclusion.

A large number of diagrams and maps have been drawn up, and work is proceeding on each of the eight projected cases. Further work has been carried out on the Coal Exhibit, help being received from Mr. T. Eastwood and from the Officers of the Fuel Research Station. The three cases in hand are as follows:—(1) Exhibit for 'Beginners,' designed as an introduction to the whole exhibit; (2) illustrating the data employed in the identification of coal seams; (3) illustrating the chief features and occurrence of British coals.

Miss Mary S. Johnston, F.G.S., has presented an excellent suite of fossil plants from the 'Upper Culm' (Coal Measures) at Roberts' Quarry, Bideford, for inclusion in the Devon exhibit.

Professor H. S. Holden, of Nottingham, has investigated coal-balls, collected by Mr. G. H. Knott in 1907, from the Halifax Hard Bed at Fieldhouse Colliery, Huddersfield, and reports the

following species: *Lagenostoma ovoides*, *Lyginopteris oldhamia*, *Botryopteris tridentata*, *B. cylindrica*, *Ankyropteris corrugata*, *Stauropteris oldhamia*, *Sporocarpion elegans*, *Sigillaria* sp., *Lepidodendron* sp., *Stigmaria ficoides*, megaspores of *Bothrodendron mundum*, *Calamostachys binneyana*, *Calamites* sp., *C. cf. charaeformis*, and a seed which will require a new generic and specific designation.

Loans of *Annularia* and of other plants have been made to Professor John Walton, of Glasgow University, for investigation. The usual assistance with regard to the palaeobotanical portions of Memoirs passing through the press has been given. The Kidston Collection of fossil plants continues to be largely used, and there is considerable correspondence connected with the miscellaneous identifications of fossil plants for outside workers. The Palaeobotanist discussed the constitution and formation of coals with Miss Taisia Stadnichenko (New York) and Dr. R. de Serpa Pinto (Porto), during their visits to the Museum.

The following specimens have been figured, described or mentioned in publications during 1932:—

IN MEMOIRS OF THE GEOLOGICAL SURVEY. SUMMARY OF PROGRESS OF THE GEOLOGICAL SURVEY OF GREAT BRITAIN AND THE MUSEUM OF PRACTICAL GEOLOGY FOR THE YEAR 1931, Part i.

Palaeobotanical Work.

By PROFESSOR H. S. HOLDEN, F.L.S., in R. CROOKALL.

Scolecopteris elegans (Brongniart), p. 75 (Kidston Collection, Nos. 6983, 7018).

IN MEMOIRS OF THE GEOLOGICAL SURVEY. SUMMARY OF PROGRESS OF THE GEOLOGICAL SURVEY OF GREAT BRITAIN AND THE MUSEUM OF PRACTICAL GEOLOGY FOR THE YEAR 1931, PART II.

VI.—*The Stratigraphical Distribution of British Lower Carboniferous Plants.*

By R. CROOKALL, D.Sc., PH.D.

Bothrodendron kidstoni Weiss, p. 82 (Kidston Collection, No. 3472).

Bothrodendron wardiense (Kidston MS.) Crookall, p. 82 (Kidston Collection, No. 26).

Lepidophloios scoticus Kidston, p. 85 (Kidston Collection, No. 2404).

Rhacopteris lindseaeformis (Bunbury), p. 94 (Kidston Collection, No. 3308).

IX.—*The Nature and affinities of Palaeoxyris etc.*

By R. CROOKALL, D.Sc., PH.D.

Vetacapsula kidstoni Crookall, pp. 129, 140, plate ii, fig. i.

IN THE NATURALIST.

The Supposed 'Lanarkian' in Shropshire.

By R. CROOKALL, PH.D.

Adiantites bondi Kidston, p. 73 (Kidston Collection, No. 2209).*Sphenophyllum* from the Millstone Grit of Northumberland.

By MISS E. DIX, M.Sc., F.G.S.

Sphenophyllum myriophyllum Crépin, p. 174 (Kidston Collection, Nos. 2577, 2578, 2579).

IN MEMOIRS AND PROCEEDINGS OF THE MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY, VOL. LXXVI.

The Relative Value of Fossil Plants in the Stratigraphy of the Coal Measures.

By R. CROOKALL, D.Sc.

Stigmara ficoides (Sternberg), pl. i, fig. 2, p. 116 (Kidston Coll. No. 2545).*Pinnularia columnaris* (Artis), pl. i, fig. 4, p. 116 (Kidston Coll. No. 2815).*Artisia transversa* (Artis), pl. i, fig. 5, p. 116 (Kidston Coll. No. 1261).*Calamites suckowi* Brongniart, pl. i, fig. 6, p. 116 (Kidston Coll. No. 2681).*Calamites undulatus* Sternberg, pl. ii, fig. 1, p. 116 (Kidston Coll. No. 4040).*Halonota tortuosa* Lindley and Hutton, pl. ii, fig. 2 (Kidston Coll. No. 2176).*Annularia stellata* (Schlotheim), pl. iii, fig. 1, p. 117 (Kidston Coll. No. 310).*Alethopteris serli* (Brongniart), pl. iii, fig. 3, p. 117 (Kidston Coll. No. 241).*Neuropteris flexuosa* Sternberg, pl. iii, fig. 5, p. 117 (Kidston Coll. No. 284).*Acitheca polymorpha* (Brongniart), pl. iii, fig. 6, p. 118 (Kidston Coll. No. 6061).*Ptychocarpus unitus* (Brongniart), pl. iii, fig. 7, p. 118 (Kidston Coll. No. 3854).*Asterotheca arborescens* (Schlotheim), pl. iv, fig. 1, p. 118 (Kidston Coll. No. 452).*Neuropteris rarinervis* Bunbury, pl. iv, fig. 2, p. 118 (Kidston Coll. No. 559).*Sphenopteris macilentia* Lindley and Hutton, pl. iv, fig. 4, p. 118 (Kidston Coll. No. 230).*Odontopteris lindleyana* Sternberg, pl. iv, fig. 5, p. 118 (Kidston Coll. No. 4078).*Sphenopteris neuropteroides* (Boulay), pl. iv, fig. 6, p. 118 (Kidston Coll. No. 228).*Linopteris münsteri* (Eichwald), pl. v, fig. 5, p. 119 (Kidston Coll. No. 820).*Neuropteris ovata* Hofmann, pl. v, fig. 6, p. 119 (Kidston Coll. No. 302).*Asterotheca oreopteridia* (Schlotheim), pl. v, fig. 7, p. 119 (Kidston Coll. No. 508).*Sphenophyllum majus* (Bronn), pl. v, fig. 8, p. 119 (Kidston Coll. No. 2701).*Dorycordaites palmaeformis* (Goepfert), pl. vi, fig. 1, p. 119 (Kidston Coll. No. 2907).*Sigillaria rugosa* (Brongniart), pl. vi, fig. 2, p. 119 (Kidston Coll. No. 2852).

- Bothrodendron minutifolium* (*Boulay*), pl. vi, fig. 4, p. 120 (Kidston Coll. No. 1845).
Lepidodendron lycopodioides *Kidston*, pl. vi, fig. 5, p. 120 (Kidston Coll. No. 2080).
Neuropteris obliqua *Brongniart*, pl. vi, fig. 6, p. 120 (Kidston Coll. No. 1137).
Neuropteris tenuifolia (*Schlotheim*), pl. vi, fig. 7, p. 120 (Kidston Coll. No. 3629).
Neuropteris heterophylla *Brongniart*, pl. vi, fig. 8, p. 120 (Kidston Coll. No. 4002).
Mariopteris nervosa (*Brongniart*), pl. vii, fig. 1, p. 120 (Kidston Coll. No. 1947).
Neuropteris gigantea *Sternberg*, pl. vii, fig. 2, p. 120 (Kidston Coll. No. 208).
Lepidodendron ophiurus *Brongniart*, pl. vii, fig. 4, p. 121 (Kidston Coll. No. 1018).
Sphenophyllum cuneifolium (*Sternberg*), pl. vii, fig. 5, p. 121 (Kidston Coll. No. 4201).
Alethopteris decurrens (*Artis*), pl. vii, fig. 6, p. 121 (Kidston Coll. No. 1149).
Dactylothea plumosa (*Artis*), *var. delicatula* *Brongniart*, pl. vii, fig. 7, p. 121 (Kidston Coll. No. 966).
Lepidophloios laricinus *Sternberg*, pl. vii, fig. 10, p. 121 (Kidston Coll. No. 1404).
Sphenopteris hoeninghausi *Brongniart*, pl. viii, fig. 1, p. 121 (Kidston Coll. No. 938).
Mariopteris acuta (*Brongniart*), pl. viii, fig. 2, p. 122 (Kidston Coll. No. 2393).

R. CROOKALL.

3. PETROGRAPHICAL WORK

The routine work of the Department, consisting of the preparation of rock-sections, registration and curation of museum material and dealing with current enquiries from outside sources, has been unusually heavy, the extent of much of the work being determined by the prospective removal of the collections to the new Museum at South Kensington.

Petrographical work has been carried out on the igneous and metamorphic rocks of the Lake District, and the Petrographer, in the summer, visited Carrock Fell, with the object of ascertaining the nature of the intrusion before dealing with the detailed petrography. Reports have been issued to the Road Board, the Imports Duty Advisory Committee and the Department of Overseas Trade; and the Petrographer has been called into consultation with the Home Office on the interpretation of the Workman's Compensation Act (Silicosis). The presence of basaltic pumice at a prehistoric site in the south-west of Skye, the existence of Niedermendig lava from an iron-age site at Cholesbury Camp near Tring, and a mass of spherulitic rhyolite occurring as a boulder beneath the Red Crag at Ipswich are points which have called for investigation. The Petrographer has examined with interesting results sections of iron-age pottery from Hembury Fort in Devonshire, Cholesbury Camp and Richborough. It can be shown that while the larger-grained components in the Cholesbury and Richborough pottery are similar, and all of flint, those of Hembury are of a variety of materials such as flint, chert, quartzite, granite and tremolite-schist, each class of material being restricted to a particular piece of pottery, thus suggesting divergence of origin and manufacture. A carved tombstone with Greek inscription found by the Port of London Authority, and probably of Romano-British age, has been examined by the Petrographer who found it to consist of a coarse white statuary marble probably of Mediterranean origin. The extent to which solution-weathering had proceeded on the back of the stone, in contrast with the sharply cut carving on the front, suggested that it had lain for a very long period on its face.

Other articles of antiquarian interest that have been dealt with are stone vessels from Nineveh and beads of various materials from Ur. Mr. Hallimond reported that a large specimen of amber found at the Roman castellum at Richborough was probably of Sicilian origin.

In Scotland Dr. Phemister and Mr. A. G. MacGregor have continued their work on the petrography of the volcanic and other igneous rocks of Sheets 23 and 14 respectively. Progress has been made with the preparation of exhibits to illustrate Scottish geology in the new Museum, and the geological models of the Ardnamurchan district have been completed. Progress has also been made towards the completion of the geological model of central Mull.

HERBERT H. THOMAS.

4. CHEMICAL WORK.

THE quantitative analyses completed during 1932 were mainly for the Shetland memoir; a selection of these is given below:—

923. *Chloritoid-muscovite-schist*. 600 yds. S. 20° E. of Δ 348, Gallow Hill, Fetlar. Six-inch map, Shetland, 17 N.W. Slice No. S 28614.
924. *Green epidotic schistose grit*. Bed of schist within schistose conglomerate. Cliff top at the Tind, Fetlar. Six-inch map, Shetland, 18 N.W. Slice No. S 28615.
925. *Sheared and schistose hornblende-epidote-albite rock*. Between Wir Geo and Mussi Geo, 450 yds. N. 32° W. of Everland, Fetlar. Six-inch map, Shetland, 18 N.W. Slice No. S 28616.
926. *Bronzite-serpentine*. Part of the large serpentine mass of the Vord Hill, Fetlar. 200 yds. S. of Δ 406, Busta Hill, Fetlar. Six-inch map, Shetland, 12 S.E. Slice No. S 28617.

LAB. NOS.	923	924	925	926	927
SiO ₂ ...	58.39	55.38	46.89	38.50	60.45
Al ₂ O ₃ ...	23.54	12.33	17.06	0.91	17.35
Fe ₂ O ₃ ...	2.43	4.94	2.17	3.20	2.52
FeO ...	5.16	3.58	6.40	4.27	1.96
MgO ...	1.88	10.32	7.45	37.82	1.30
CaO ...	0.33	6.28	8.81	1.19	2.04
Na ₂ O ...	1.07	1.36	3.77	0.31	6.84
K ₂ O ...	2.90	0.68	0.41	0.00?	5.51
H ₂ O > 105° ...	2.82	3.35	3.12	12.02	0.58
H ₂ O < 105° ...	0.12	0.27	0.17	0.84	0.13
TiO ₂ ...	1.22	1.07	2.41	0.69	0.95
P ₂ O ₅ ...	0.07	0.12	0.29	0.00?	0.48
MnO ...	0.02	0.13	0.11	0.16	0.20
CO ₂ ...	0.00?	0.24	0.75	0.00?	0.00?
FeS ₂ ...	0.00?	0.10	0.08	0.00?	0.07
Cr ₂ O ₃ ...	0.00?	0.10	0.10	0.25	—
NiO } ...	—	—	—	0.21	—
CoO }	—	—	—	—	—
TOTALS ...	99.95	100.25	99.99	100.37	100.38

Analysed by

B. E. DIXON.

927. *Trachyte*. Elongate mass intrusive in Tertiary plateau basalt lavas. Crag on S. side of Lochan a' Bhuinn a' Se, N. end of Cnoc Carach, 2½ miles W. of Kinlochaline, Morvern. Six-inch map, Argyll, 54 S.E. Slice No. S 28389.
928. *Practically unfoliated part of the Hildasay granitic syenitic mass*. Fugla Ness, 440 yds. W. 21° S. of pier, Hamnavoe, W. Burra. Six-inch map, Shetland 56 S.W. Slice No. S 28390.
929. *Foliated hornblendic edge of the Hildasay granitic syenitic mass*. Shore 300 yds. S. 35° W. of pier, Hamnavoe, W. Burra. Six-inch map, Shetland, 56 S.W. Slice No. S 28391.
930. *Foliated basic rock*. Field immediately behind Mousewall farmhouse, Tingwall. Six-inch map, Shetland, 52 N.E. Slice No. S 28392.

LAB. NOS.	928	929	930	932	934	939
SiO ₂ ...	64.95	54.05	49.81	55.79	64.46	50.90
Al ₂ O ₃ ...	16.09	15.13	15.97	25.17	14.60	15.06
Fe ₂ O ₃ ...	2.29	4.28	1.13	7.07	2.19	0.93
FeO ...	1.37	4.42	9.61	2.53	4.36	7.13
MgO ...	1.37	3.69	4.93	1.93	2.78	7.31
CaO ...	3.86	7.03	8.94	0.68	3.50	9.98
Na ₂ O ...	4.28	4.13	4.12	1.12	2.62	3.51
K ₂ O ...	3.90	4.46	0.59	3.00	3.31	0.68
H ₂ O > 105°	0.47	0.52	0.92	1.29	0.67	1.21
H ₂ O < 105°	0.13	0.06	0.10	0.10	0.04	0.32
TiO ₂ ...	0.70	1.31	3.05	1.51	1.18	2.50
P ₂ O ₅ ...	0.25	0.78	0.44	0.04	0.32	0.23
MnO ...	0.09	0.18	0.18	0.10	0.10	0.18
CO ₂ ...	0.00?	0.00?	0.12	0.00	0.00?	0.20
FeS ₂ ...	0.12	0.04	0.12	—	0.00?	—
Cr ₂ O ₃ ...	—	—	0.02	—	—	0.05
Rare earths	0.03	0.00?	—	—	—	—
TOTALS...	99.90	100.08	100.05	100.33	100.13	100.19

Analysed by

B. E. DIXON.

932. *Garnet-staurolite-kyanite-gneiss* (Valla Field Gneiss). Cliff top 490 yds. N. 35° W. of Δ 558, Libbers Hill, Unst. Six-inch map, Shetland, 2 S.W. Slice No. S 29291.
934. *Felspar-blebbed gneiss* (Westing Gneiss). 660 yds. S.W. of Lund farmhouse, Unst. Six-inch map, Shetland, 8 N.W. Slice No. S 29293.
939. *Epidiorite*. Dyke in Gabbro. West of England Roadstone Company's quarry, S. side of Porthoustock Cove. Six-inch map, Cornwall, 81 S.E. Slice No. E 15960 and E 15961.
931. *Stichtite* with some chromite, serpentine, etc. Cunningsburgh. Six-inch map, Shetland, 59 S.E.

LAB. NO.				931	
				A	B
SiO ₂ ...	...	...	...	8.51	
Al ₂ O ₃ ...	...	...	...	1.10	
Cr ₂ O ₃ ...	...	...	...	27.10	17.75
Fe ₂ O ₃ ...	...	...	...	6.52	3.50
FeO ...	...	...	...	8.95	
MgO ...	...	...	...	26.72	39.49
CaO ...	...	...	...	0.10	
MnO ...	...	...	...	0.05	
CO ₂ ...	...	...	...	3.14	6.83
H ₂ O > 105°	...	...	...	17.46	32.43
H ₂ O < 105°	...	...	...	0.24	
TOTALS	...	...	...	99.89	100.00
Analysed by				B. E. DIXON.	

Lab. No. 931 represents the first reported occurrence in Europe of stichtite, described by Professor H. H. Read. The analysis of the mineral, contaminated with chromite, serpentine, etc., is given in Column A, and the composition of the pure mineral as determined by an extraction method, in Column B. The mineral is to be described and the formula discussed in a forthcoming number of the *Mineralogical Magazine*.

B. E. DIXON.

IV. MUSEUM OF PRACTICAL GEOLOGY

THE total attendance of visitors for the year was 20,497; of these 1,365 were Sunday visitors. Seventeen demonstrations were given to accredited parties from schools, scientific and technical institutions, the total attendance at these being 354.

Apart from the routine work entailed by public enquiries, cataloguing and registration, the Museum staff has devoted its time entirely to the preparation of the exhibits for the new galleries at South Kensington and to work in connexion with the provision of furniture and equipment for the new building which will shortly be ready for occupation. The popular and introductory displays for the ground floor and the economic exhibits for the second gallery are now well advanced and several district exhibits for the first gallery, devoted to the regional geology of Great Britain, are in progress. The work of assembling and arranging the material, together with the preparation of labels and explanatory diagrams, is being carried out by the combined staffs of the Survey and Museum with the occasional assistance of outside artists for special displays. Enlargements of Survey photographs are being extensively used to illustrate the various exhibits and a large and representative series has now been assembled. When necessary, these have been supplemented by foreign photographs illustrating chiefly geological processes and important economic occurrences.

In collaboration with Professor E. F. Herroun, the Assistant-Curator continued magnetic research work and a report dealing with the first part of the investigation has been prepared. The Curator completed a research into the metamorphism produced by the combustion of hydrocarbons in calcareous sediments.¹

Exhibits illustrating Survey work were prepared for the British Association meeting at York and for the Annual Conversazione of the Geologists' Association. At the latter meeting opportunity was taken to exhibit the recently constructed geological model of the Weald which excited considerable interest.

The Library has shown steady growth throughout the year and continues to be freely used as a centre of information by specialists and members of the public. Accessions during the year comprise 193 volumes of independent works, 121 pamphlets, 3,215 volumes and parts of serials, 378 maps, and 120 geological photographs; 1,975 pamphlets, presented by the Director, have been indexed and incorporated into the collection. The public orders comprised 740 photographic prints and 254 lantern slides.

W. F. P. McLINTOCK.

¹ McLintock, W. F. P., 'On the metamorphism produced by the combustion of hydrocarbons in the Tertiary sediments of south-west Persia,' *Mineralogical Mag.*, vol. xxiii, no. 139, 1932, pp. 207-226.

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